A MODEL FOR DEVELOPING AND DISSEMINATING MULTIMEDIA MATERIALS FOR TEACHER EDUCATION

Linda S. Hodges, B.A., M.S.

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APPROVED:

Randolph Steven Tipps, Major Professor
James L. Poirot, Major Professor
James Roberts, Minor Professor
Ronald Wilhelm, Committee Member
James Laney, Coordinator of the Program in Curriculum and Instruction
John C. Stansell, Chair of the Department of Teacher Education and Administration
M. Jean Keller, Dean of the College of Education
C. Neal Tate, Dean of the Robert B. Toulouse School of Graduate Studies

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The purpose of this study was to develop a model that would enhance the development, dissemination, and adoption of educational multimedia materials.

The grounded theory definition of open coding was used to analyze data collected from the 3-year Technology Leadership Web Library Project at the University of North Texas. Weekly meeting minutes, email communication, reports, notes, questionnaires, and surveys were examined to determine major factors involved in the process of product development and dissemination.

From the analysis of this study, five major factors in product development and dissemination were identified. These factors were leadership, team dynamics, expert advisors, feedback, and consumers. The synthesis of the factors led to the development of the PROMOTE (process revolving around ongoing management of team and evaluative feedback) model. The PROMOTE model is based on the establishment of a system that includes leadership, development team, and expert advisors at its center. The system is tied together with well-established feedback loops for stages of evaluation. The PROMOTE model is iterative and uses consumer feedback to generate new products.

The PROMOTE model differs from other product development and evaluation models both in the focus of the process and the nature of the evaluation feedback.

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INTRODUCTION

Despite the fact that computers and other technologies are becoming an increasingly accepted part of everyday life in both the home and workplace, higher education faculties are failing to integrate information technology into the teaching and learning process (Geoghegan, 1994). Higher education students need to be exposed to the computer tools that will be an inevitable part of their future lives (Brown, Burg, & Dominick, 1988), but convincing faculty members to try new technologies and incorporate them into their teaching is a challenge (Cottrell, 1997).

The number of university faculty members who recognize the potential of instructional technology and are enthusiastic about adopting it is growing, but a large number of faculty members remain reluctant to adopt technology for their teaching (Jacobsen, 1998). Efforts to infuse technology into teacher education programs face obstacles of funding, inadequate staff development, time constraints, faculty resistance, and poor planning (Pan, 2000). These are just some of the hurdles that need to be overcome if technology-integrated curriculum is to be embraced by higher education faculty.

The form of schools and education and the uses of technology in teaching have remained virtually unaltered for hundreds of years despite pedagogical and technical influences (Bohm & Nulden, 2000). Pedagogical practices now differ little from the days when the primary teaching tool was the chalkboard. Even with the introduction of more modern tools, teaching has scarcely changed. As society is inundated with new

technologies that have begun to move into the classrooms, education will require change to meet the new demands of teaching and learning (Jacobsen, 1998).

"Technology's advance may be inevitable, but it is gradual" (Surry & Farquhar, 1997). Faculty needs in the areas of staff development and technology training are not being met (Jacobsen, 1998). As technology advances at accelerating rates, introduction of it into instruction must be swift. An approach that will speed up the use of educational technology must be found, or education will continue to lag behind the rest of society.

Statement of the Problem

"Typically, college courses don't teach teachers in ways they are now being asked to teach" (Sparks, 1997). Teachers are expected to use the technologies in which schools are heavily invested, but seldom see it modeled in teaching courses. Baty (2000) concluded that teachers entering the field need to know topics related to both the teaching and pedagogical role of computers as well as the subject specific material, examples of interactive software through demonstrations and hands-on experience, and the differences in WAN (wide area network) and LAN (local area network) resources for both accessibility and sharing. Most preservice teachers are not being exposed to this knowledge in their coursework. At least one research study indicated only about 4% of faculty are using multimedia as learning tools (Green, 1995).

The educational community must find ways to encourage adoption of informational technology by faculty on college campuses. The problem is that no successful strategy exists that applies theories that support the change process as a whole and thus, there is "value in uniting the empirical knowledge base of classical models" (Ellsworth, 2001, pp. 24-5). Models of product development, dissemination, adoption,

and evaluation are for the most part stand-alone theories that result from one-shot surveys and after-the-fact descriptive studies. By exploring change from initial research through user application of the final product, a greater understanding of what it takes to promote faculty acceptance of technology may be gained. "By uniting tactics to produce a guiding strategy, we improve chances of an effective, lasting change" (Ellsworth, 2001, p. 25).

Purpose of the Study

The purpose of this study was to present a grounded theory for product development, dissemination, adoption, and evaluation based on research guided by two major research questions: What are the major factors to be considered in the creation and adoption of multimedia materials for teacher education faculty? How can feedback be used to guide the process from research and development through dissemination and adoption? For the purposes of this research, grounded theory is defined as "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin & Turner, 1986, p. 141).

From the results of this study, it was hoped that a generalized theory would emerge that could provide a model for development and dissemination of multimedia tools for educators.

Research Questions

Question 1: What major factors need to be considered in the creation and adoption of multimedia materials for teacher education faculty?

Question 2: How can feedback be used to guide the process from research and development through dissemination and adoption?

Definitions

Adoption is the decision to use the product in whatever form is most suitable to meet the needs of the adopter.

Coding is a way of conceptualizing data by raising questions and assigning labels, thus developing provisional explanations.

Development, according to Rogers (1995, p. 17), "is the process of putting a new idea in a form that is expected to meet the needs of an audience of potential adopters."

Dissemination is the dispersion of the multimedia materials among college faculty and their students.

Evaluation involves the examination of feedback to determine whether or what action needs to be taken.

Feedback includes any types of communication returned to the product development team.

Grounded theory is a method of doing qualitative analysis that includes theoretical sampling and methodological guidelines such as constant comparisons and coding and memoing (Strauss, 1987).

An *innovation,* according to Rogers (1995), is an idea, practice, or object that an individual adopter perceives as new.

Instructional technology is a complex, integrated process for analyzing problems and devising solutions that are related to all aspects of human learning (Albright, 1996). It is concerned with the instructional setting, the instructional information, and the information media's ability to develop and to deliver maximized learning.

Integration of technology means the adoption of computers and other technologies and a "transformation or re-invention process where instructional strategies and outcomes are redefined by technology" (Jacobsen, 1998).

A *memo* is "the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding" (Miles & Huberman, 1994, p. 72).

Multimedia means the integration of video, sound, graphics, and text using the computer and Internet to provide interactive access to information.

A *prototype* is the original model that serves as the design for future product.

Usability is defined by Osterbauer, Kohle, Grechenig, and Tscheligi (1994) as "a measure of the ease with which a system can be learned or used, its safety, effectiveness and efficiency, and attitudes of its users toward it."

Delimitations and Limitations

The materials researched in this study were focused on the Technology Leadership Web Library (TLWL) project managed by the Texas Center for Educational Technology at the University of North Texas. This single-case study involved examining the processes of development, dissemination, adoption, and evaluation of multimedia products for education. The fact that the research was based on a single case study suggests that additional research from other cases is needed to develop a more generalized theory.

Since the beginning of the TLWL project, I was involved first as a curriculum developer and then as team manager. During my research on the project, I was constantly aware of conflict that might develop as a result of my dual roles. Whenever the two positions became confused, I divorced myself from the role as team manager and focused

on how the data addressed the team and the leadership position. At other times during the study, my role as team manager allowed me an intimate interpretation of the data. These opposing viewpoints provided constant challenges to balance the research and minimize researcher bias.

Perhaps the most serious limitation to this study was time. The TLWL project extended over 3-years during which time the product was continuously developed and disseminated. This framework allowed for a comprehensive study of the development, dissemination, and first stages of adoption, but the adoption data were incomplete. Although many educators and students used the materials, I believe that during this study the market for these materials had not reached its full potential. During the TLWL project timeframe studied in this research, users had not been exposed to the materials long enough to move through the various levels of adoption as outlined in the concerns-based adoption model (Hall & Hord, 1987).

A truly random sampling of users was not possible because only data collected from educators who chose to test and use the product were documented; however this was not a factor in the development of the model. For further study of the product adoption, more data would need to be collected from non-users.

Significance of the Study

This study is significant for two reasons. First is the way in which the data were collected to include all documents generated by a 3-year project. Second, the study focused on synthesizing the processes of product development, dissemination, adoption, and evaluation to create a single iterative model.

As to the first significant aspect of this research, the study was data-rich. The research involved a single case study replete with formative feedback, detailed documentation, and evidence of several iterations of the products as they underwent development and dissemination simultaneously throughout the study. Most diffusion research designs involve one-shot surveys that require those responding to recall when and why they made certain decisions at the end of the study (Rogers, 1995). Generally, product development models fail to take into account adoption or diffusion, or they are not considered until the end of the development process (Surry & Farquhar, 1996).

Data collected and analyzed for this study represented all available communication, feedback, and statistics generated during the entire existence of the TLWL project. Data included candid remarks and notes that added insight into the feelings and beliefs of the people involved in the project. Diffusions studies generally lack the emotional aspects that are available in this qualitative study.

As to the second significant aspect of this research, there has been no successful synthesis of diffusion models that allows users to work from a single model. Ellsworth (2001) wrote that

> simply applying the tactics suggested by a classical model to facilitate the operation of a single component of the change communication model, or applying several in isolation to their corresponding components, will not maximize the overall effort's chance of success. (p. 33)

The problem faced by instructional technologists is that no single model or theory is applicable through the various stages of development and adoption because of the lack of research that expands the entirety of product development. "The pioneers erected the

structure; their successors populated it with empirically grounded theory. Yet as practitioners of educational change there is no successful strategy to apply the theories in support of the change process as a whole" (Ellsworth, 2001, p. 24).

Surry and Farquhar (1997) suggested that the most likely reason for the failure to create such a unified theory is that the interview-based methodology used in the 1943 Ryan and Gross agricultural study of innovation diffusion is still the predominant diffusion research method used today. The research of the TLWL project departed from the descriptive research typically applied to the study of the diffusion of innovations. It was supported by a wealth of data that were open to broad interpretations and cross-examinations for comparisons.

CHAPTER 2

REVIEW OF LITERATURE

A profusion of literature covering the various methods and theories of product development, dissemination, adoption, and evaluation exists. Many of these models are similar. For the purpose of this study, I have chosen to examine the most widely accepted and used instructional development models, product evaluation models, and innovation-adoption evaluation models. The models discussed in this chapter are organized in Table 1. The discussion ends with Systems Theory.

Table 1

Outline of Discussed Literature Review

Research, development, and diffusion models	
Stockdill & Morehouse	Technology adoption model
Bergman & More	Product orientation I D model
Ernest Burkman	User-oriented instructional development
Evaluation models	
Wilson	Rapid prototyping
J. H. Allen	Usability testing
T. Sullivan	User Testing Checklist
Hall, Hord, Loucks-Hursley, & Huling	Concerns-based adoption model
Systems theory	

Research, Development, and Diffusion Models

> Revolutions in teaching, or in anything else for that matter, are created by revolutionaries, not by their hardware, though good hardware properly employed can certainly help them succeed. But no revolution, no matter how well financed and equipped, and no matter how good the motivating ideas, will be successful if the revolutionaries and their supporters fail to convince a significant proportion of the general populace to follow them past barricades. (Geoghegan, 1994)

Research

The initial stage of the development of any product is research to analyze and understand the users' needs. Stockdill and Morehouse (1992) outlined a process called the Technology adoption model that involves identifying the factors of a new educational technology after a complete analysis of educational need and the user's characteristics. The model is a synthesis of many other diffusion models and includes (a) front end analysis, (b) prototype development, (c) small scale analysis, (d) organizational adoption, and (e) institutionalization.

The first step of the model is the front-end analysis. Stockdill and Morehouse (1992) introduced the Critical Factors in Adoption Checklist © (CFAC). The checklist presents five categories: instructional need, user characteristics, content characteristics, technology considerations, and organizational capacity. The Technology Leadership Web Library (TLWL) team considered the user characteristics and the content characteristics in the development of the multimedia product. The instructional need was analyzed

during the proposal stage of the project and continued to be analyzed during the execution of the project as part of the ongoing feedback.

The second category of the CFAC is user characteristics. Users are unique in many ways. Each has a preferred learning and teaching style. Each has his or her adopter type that determines at what stage of the innovation he or she will be more likely to be open to acceptance. Adult learning includes user experiences and perceived relevance of the new tools. These factors were considered in the development and dissemination of the product studied in this research. User characteristics considered by the TLWL team are listed in Table 2, along with the supporting references.

Table 2

Adult Technology User Characteristics

User characteristics	Reference
Desire self-direction and empowerment	
Use experiences as a part of learning	
Prefer environments that foster critical and reflective thinking	Moore (1988)
Are motivated by learning for action	
Look for problem solving	
Do not tolerate self concept threaten	Cravener (1998)

(table continues)

Table 2 (*continued*)

User characteristics	Reference
Need to manage and control environment	
Learn through interacting with the environment	Habermas (1972)
Become emancipated through self-reflection	
Are relevancy oriented	Viechnicki, Bohlin, & Milheim (1990)
Are confident in themselves as educators	
Show a strong view of personal learning	Falba (1997)
Are enthusiastic about promoting technology	
Are primarily interested in teaching and learning	Frayer (1994)
Are reflective practitioners looking for worth in the tool	
Look for relative advantage to teaching and learning	
Want applications with low risk of failure	Jacobsen (1998)
Prefer clear step-by step examples	
Prefer hands-on	

(table continues)

Table 2 (*continued*)

User characteristics	Reference
Need compelling evidence technology offers value	
Want tools that improve performance of existing task	Geoghegan (1994)
Want tools that improve quality of teaching and learning	
Have a low tolerance for things that don't work, complicated, don't like	Osterbauer et al. (2002)
Do not like the use of a lot of technology terms that are unfamiliar	Westbrook & Boethel (2001)

The third category of the CFAC is content characteristics. The content must fit the user's skills, knowledge, and personality. Although multimedia provides flexibility for the user and is easily adapted by different users, the design and content must nonetheless be carefully fitted to attract and make the user feel comfortable. The TLWL team considered the content characteristics identified by Rogers's Five Attributes: (a) Relative Advantage, (b) Compatibility, (c) Complexity, (d) Trialability, and (e) Observability (Rogers, 1995). Of the five attributes, compatibility of the multimedia product with what and how the user taught was the prominent concern determined by feedback in this study. I used the term *relevancy*, reflecting back to the user's characteristics, to discuss compatibility. Relative advantage was the second most frequently discussed attribute in determining whether the consumer chose to use the product. The prototype testers and

beta testers dealt with the product attribute of complexity. In the study, user friendliness, functionality, and user control defined that attribute. Observability was a factor of the product dissemination and was measured by statistical data in this study.

The fourth and fifth categories of the CFAC are technology considerations and organizational capacity. Technology considerations played a major role in the TLWL product development process but were beyond the scope of the two research questions addressed in this study. Organizational capacity required an understanding of the type of management system, communication, and economic situation. Since the case study in this research did not focus on adoption by entire institutions, but rather by individual choice, this category was not considered.

The technology adoption model is appropriate to guide an institution's diffusion of an innovation, but its organizational focus was too limited to apply to this study. The Critical Factors in Adoption Checklist, part of the initial research focus of the technology application model, was adapted in part and used to focus the product developers on user characteristics and product attributes.

Development

The goal of production development models is to produce an effective and efficient product as quickly as possible (Gustafson, 1991). Gustafson organized the most widely used instructional development models into an organized taxonomy composed of three parts. Gustafson and Branch categorized and defined these models.

1. The Classroom Orientation Instructional Development Model is a roadmap to help master teachers design appropriate classroom tools.

2. The Product Orientation Instructional Development Model addresses the development of products that apply short-term use.
3. The System Orientation Instructional Development Model involves developing an entire course or curriculum. (Gustafson, 1997)

Instructional development (ID) models are defined by four major activities (Gustafson, 1997). The first activity is to analyze the setting and the user needs. The second is to design a set of specifications for an effective, efficient, and relevant learner's environment. The third activity is described by the development of all learner and management materials. Finally, the fourth activity is the formative and summative evaluation of the results. According to Surry and Farquhar (1997), the ID models are based on behavioral science and limited by the fundamental deterministic bias that a superior product will automatically be embraced and adopted by users.

Gustafson and Branch defined the product orientation ID model by products that will have short-term use by the adopter (Gustafson, 1997). Short term, as defined by this model is a few hours or a few days. The product developed in this case study falls into the short-term definition, because the TLWL team designed the multimedia modules to model the use of technology in 10 to 30-minute video-driven units.

Plotnick (1997) characterized product orientation ID models by four features: (a) the assumption that an instructional product is needed; (b) the assumption that the required instructional product is not currently available and needs to be produced; (c) the assumption that a variety of instructional managers will use the product; and (d) The emphasis placed upon trial and revision.

The Bergman and More model is listed as one of the product orientation ID models. The application of the Bergman and More model to this project is apposite, because the model is especially suited for design and production of interactive video and multimedia and it emphasizes team coordination and management. The model lists six major activities: (a) analyze, (b) design, (c) develop, (d) produce, (e) author, and (f) validate. Although the ID model progresses from the identification of goals through the formative evaluation, revision, and final evaluation, it is lacking in any mention of the social context, according to Surry and Farquhar (1996). They pointed out that this is a shortcoming of the model, because the design, development, adoption, utilization and diffusion of technology are inherently social processes.

Diffusion

Burkman was one of the first to develop an adoption-utilization theory. Motivated by the opinion that educational technology could be better utilized, Ernest Burkman turned to diffusion theory for a solution (Surry & Ely, 2001). He focused on social factors important to instructional design in his theory titled user-oriented instructional development (UOID). The model focuses on perceived attributes as central to the development of instructional products that users would find appealing. Components of his model include: (a) identifying the potential user; (b) measuring relevant potential adopter perceptions; (c) designing and developing a user-friendly product; (d) informing the potential adopter of the product's user-friendliness; and (e) providing post-adoption support.

Burkman recognized that the research development diffusion (RDD) paradigm was not adequate to produce instructional products that people wanted to use (Surry &

Farquhar, 1996). The UOID model considers the potential adopter to be the primary force that influences the adoption of the innovation. The user's needs, perceptions, and opinions drive the development of the product. Surry and Farquhar (1997) cautioned that a totally instrumental philosophy driven by user desires would result in technically and pedagogically inferior products.

In contrast to the adopter-based (instrumentalist) theory focusing on human, social and interpersonal aspects of the innovation diffusion, the developer-based (determinist) theory focuses on the technology as an autonomous force beyond human control (Chandler, 1995). The goal is to increase diffusion by maximizing the efficiency, effectiveness, and elegance of an innovation. The assumption is that change will occur if a product that is significantly superior to existing ones is introduced into the system. Determinists fall into two classes, the utopian determinists, who believe technology is a positive force; and the dystopian determinists, who believe that technology is an inherently evil force that will lead to the moral, intellectual, or physical destruction of humankind. None of the determinist models were considered in this study because they were void of the social context upon which the TLWL project was built.

Drawbacks to RDD Model

According to Surry and Farquhar (1996), instructional developers commonly use the research development diffusion (RDD) model in their product development. Although the framework of this model appears to provide effective instruction, it is faulty because of its dependence on the conviction that the introduction of increasingly complex technology drives society forward. The fallacy of this "technology push" philosophy is

manifest in the failure of many high-quality curriculum projects developed in the 1960s (Surry & Farquhar, 1996).

After examining several instructional design models, Surry and Farquhar (1996) concluded that none of the widely used product development models includes an analysis of the social context as an important part of the development process. Those models that do consider the social context do not use it to guide product development. Adoption and diffusion are often left unmentioned or are not considered until the end of the development process. According to their evaluation, Surry and Farquhar found that most of the RDD tools, adoption analysis, user-oriented instructional development, rapid prototyping and field testing, have not been examined in practical settings, and thus there is no evidence to suggest that they will result in the increased adoption or implementation of the instructional products.

Evaluation Models

Product evaluation is an essential part of the instructional development process (Surry & Farquhar, 1996). Surry and Farquhar identified rapid prototyping, usability testing, implementation evaluation, and field testing as the major formative evaluation methodologies. Each of these methods incorporates a cycle of feedback from selected individuals within the target population. Surry and Farquhar concluded that the most successful evaluation methods are conducted in social environments similar to the environments of the end users.

Rapid Prototyping

Advantages of rapid-prototyping. Rapid prototyping allows the product to be visible and undergo testing during the early stages of development (Wilson, Rauch, &

Page, 1992). As pointed out by Wilson et al., rapid prototyping enhances communication within the development organization. The early testing exposes obvious functionality and usability problems before too many resources have been devoted to a flawed design.

Perils of not prototyping. Wilson et al. (1992) warned that if the product does not begin with a prototype, the developers are susceptible to risks. Among the risks they included the chance of losing the competitive positioning, encountering expensive design correction costs, losing touch between the team and the user, failing to meet the guidelines, and not enough testing. Rapid prototyping and testing are the first steps in continuous quality control.

Perils of prototyping. Prototyping can expose the project to certain pitfalls (Wilson et al., 1992). The tools tend to become more important than the users when prototyping. Focus is drawn away from the consumer as the team concentrates on building and fixing the product. Another problem faced by prototyping, according to Wilson et al., is that the developers tend to be trapped by an endless loop of product refinement and the original reasoning for decisions becomes lost. They also suggested that good ideas that seem expensive may be rejected too early in the project because of an effort to get the product developed quickly.

The TLWL closely monitored prototype testing and identified testers. Well-defined feedback networks functioned to discourage the suggested pitfalls. Feedback networks limited external feedback, kept expert advisors aware of what was happening, and encouraged communication within the team.

Usability Testing

According to Allen (1994), one solution to insure that products are easy to employ is usability testing. This test provides foresight to the developers concerning how people use a product before it is disseminated. He added that usability testing must include a systematic effort using established methods. The systematic usability testing includes knowing the user, participatory designing, coordinating design, prototyping, and testing both designed systems and systems under design.

Lee (1999) defined the following usability testing dimensions categories (a) learnability, (b) performance effectiveness, (c) flexibility, (d) error tolerance and system integrity, and (e) user satisfaction. Sullivan (1996) developed a user-testing checklist for Web sites that included: (a) clarity of communication, (b) accessibility, (c) consistency, (d) navigation, (e) design and maintenance, and (f) visual presentation. The TLWL divided Lee's list and Sullivan's list into two categories: One list focused on the end user needs and preferences, and the other list was based upon product functionality issues. The end-user testing was called beta testing, and the product functionality testing was referred to as prototype testing. This division allowed the product developers to focus individual concerns on either the user or the product.

Concerns-Based Adoption Model

According to the Illinois Staff Development Council (2002), one of the most important and most widely used of all staff development models is the concerns-based adoption mode (CBAM). The model was created to explain the lack of teacher buy-in and to propose ways of using the model to increase implementation of educational innovations. The model is based around three tools. The Stages of Concern (SoC)

measures teachers' attitude; the Levels of Use (LoU) measures teachers' behaviors; the Innovation Configurations (IC) Matrix identifies the different ways teachers adopt innovations to address their unique situations. These are diagnostic tools used by change agents and school district administrators to aid the effective adoption of an innovation.

The CBAM tools were designed to diagnose problems with innovation adoption. They were based on guiding the user to use the innovation properly as intended by the design team. The TLWL products were designed on flexibility of use, with no proper format prescribed. The TLWL team used the LoU instrument to measure the users' behaviors concerning the innovation. Table 3 lists the various levels in the Levels of Use according to the CBAM. The actual instrument used by the team was modeled after the CBAM LoU, but was not CBAM-certified. This tool satisfied the needs of the TLWL project, but it was not used in the customary way for which it was designed.

Table 3

CBAM Levels of Use

CBAM description	CBAM level	Level no.
State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.	Nonuse	0
State in which the user has recently acquired or is acquiring information about the innovation and/or has recently explored or is exploring its value orientation and its demands upon user and user system.	Orientation	1

(table continues)

Table 3 (*continued*)

CBAM description	CBAM level	Level no.
State in which the user is preparing for the first use of the innovation.	Preparation	2
State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.	Mechanical Use	3
Use of the innovation is stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.	Routine Use	4a
State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short and long term consequences for clients.	Refinement	4b
State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.	Integration	5

(table continues)

Table 3 (*continued*)

CBAM description	CBAM level	Level no.
State in which the user re-evaluates the quality of use of the innovation, seeks major modifications of or alternatives to present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.	Renewal	6

Note. Table based on Hall and Hord (1987).

Systems Theory

Systems theory (Surry & Farquhar, 1996) attempts to create a holistic view of the change process by identifying all the inputs and outputs of the system. The belief behind this theory is that all of the components must adjust to fit any changes made due to the introduction of the innovation. As with many systems, the foreign component may initially be viewed as destroying the balance, and an effort to reject it will be made. This is particularly true if the component is introduced in isolation (Ellsworth, 2001).

James Finn was the father of the instructional design movement. In the 1960s the military infused this model into training. It was also during this time that the components of the system for instructional design were defined (Seels, 1989). The instructional systems design (ISD) ADDIE model includes five stages: (a) analysis, (b) design, (c) development, (d) implementation, and (e) evaluation. The stages overlap, thus allowing for testing and redesign as the product develops. An example of this model is the continuous process improvement (CPI) model (Clark, 1998). In this model the analysis,

design, development, and implementation stages each loop back to the evaluation stage. The process is nonlinear, moving over any of the defined process paths. The purpose of the model is to identify needs and correct problems. The CPI model explains a production process from the aspect of innovation development but is open-ended and fails to address many issues, such as feedback and collaboration, faced in the TLWL project. The roles of leadership and team dynamics are also absent from the CPI model.

CHAPTER 3

METHODS AND PROCEDURES

The research in this study was focused on the Technology Leadership Institute (TLI) project. The TLI project was funded by the U.S. Department of Education in September 1999. One of its components, The Web Library, created an online resource for multimedia educational curriculum materials. During the last 3 years, documentation of weekly meetings, creation and revision dates, Web site statistics, product specifications through several iterations, and many other aspects of the projects were maintained. Formative assessment and feedback were collected throughout this project.

The purpose of this study was to distill the extensive TLWL paperwork and identify patterns that could be used to create a new diffusion model. The mere wealth of information collected made this project ripe for investigation, pattern recognition, and drawing of conclusions. The qualitative approach used in this study was atypical of the prominent models of change and innovation diffusion theories.

Assumptions and Rationale for Qualitative Study

I chose to use the grounded theory approach in this research because that methodology allowed me to study the large quantity of diverse data and analyze that data without preconceptions. Grounded theory permitted a focus on the contextual and processual elements of this single case study. The data were comprehensive, with broad interpretations based on a meshing of existing theories and methods. Even though the study contained quantifiable data, the true representation of the project required qualitative interpretations.

Most diffusion research designs consist of correlation analysis of cross-sectional data gathered in one-shot surveys that provide nothing more than snapshots of behavior (Rogers, 1995). Rogers believed that studies should rely on "moving pictures" that trace the sequential flow of an innovation as it unfolds. Data collected during this project provide just that. Miles and Huberman (1994) wrote that theories should be built to account for the real world that account for events – not simply document them. In this study, I used the documents to tell a story that translated into a theory described by a model of the project.

This case study followed educational multimedia products from initial research and development through dissemination, adoption, and evaluation. Although there are many existing theories related to development, dissemination, adoption, and analysis of instructional technology, a general model that merges these theories is lacking. The grounded theory method made possible the emergence of a model that focused development and adoption into a unified process that was both iterative and symmetric.

The Type of Design Used

The heart of the grounded theory approach is to develop theory. Grounded theory is not bound to any particular methodology, nor is it dedicated to any particular kind of data, research, or theoretical interests (Strauss, 1987). Strauss explained grounded theory as a style of doing qualitative research that involves theoretical sampling, methodological guidelines, the use of constant comparisons and a coding paradigm that considers the conditions, interaction among the actors, strategies and tactics, and consequences.

"The methodology of grounded theory is iterative, requiring a steady movement between concept and data, as well as comparative, requiring a constant comparison across

types of evidence to control the conceptual level and scope of the emerging theory" (Orlikowski, 1993, para. 13). Grounded theory assumes that social phenomena are complex (Strauss, 1987). This methodology encourages the development and linkage of many concepts that will ultimately dissolve into a clear picture, and the theory will emerge.

I based this study on existing documents from the TLWL project. The documents reflected all aspects of the project. Using grounded theory, I was able to examine the massive documentation and organize the many ideas. The documents encompassed a variety of data types, ranging from impersonal statistics to private communications.

The Role of the Researcher

My role in this study extended beyond that of the case-study researcher. I was a team member throughout the evolution of this project. In the 2nd year of the project, I became the full-time team manager. I led a team that consisted of Web developers, curriculum specialists, master teachers, programmers, videographers, editors, and faculty advisors.

As a team member, I participated in developing the curricular component of the multimedia product and resources. I also worked in the field as a change agent and distributor of the materials generated by the project. This role permitted me first-hand access to the educational community's interaction with the product. This information enhanced my ability to interpret data from the user groups.

As an experienced workshop leader, I had opportunities to test the materials in the field. My background made it possible for me to be accepted in multiple venues, as presenter at both science and educational conventions, and in classrooms for graduate

studies, undergraduate, and K-12 students. My acceptance in these communities provided a multiplicity of candid feedback.

Strauss (1987) outlined the necessity of experiential data to provide technical knowledge, derived from research and personal knowledge, as essential to providing theoretical sensitivity and a wealth of provisional suggestions. He also pointed out that using the triad of data collection, coding, and memoing controls research bias. My personal role in this project enhanced my understanding of the data and their interpretations. I was cognizant of biases that could have developed, particularly concerning my role as team manager. I attempted to eliminate personal bias that could result in the over-estimation or underestimation of the effects of team leadership. I accomplished a reasonably bias-free interpretation of leadership by triangulating data and examining the role of team leader as a management position and not as a personal role.

Data Collection Procedures

The data collected and analyzed in this study came from documents preserved during TLWL activities. The unorganized materials included hand-written, unedited minutes from weekly team meetings, email and other written communiqué, reports from a variety of sources, responses to questionnaires and surveys, observation notes, notes from miscellaneous meetings, and product distribution and Web statistics. I obtained the materials from team members and archived files. None of the materials had been categorized or coded. The questionnaires and survey materials included only the responses, without analysis.

The original sources of the documents were wide-ranging. Meeting documents included team members, the team manager, the project manager, the project director, and

faculty advisors. Reporting sources included those people previously mentioned, as well as the project evaluator and focus group. Questionnaires and surveys were collected from higher education faculty members, students in various education courses, and inservice teachers. Email and notes came from all the previous sources and included individuals identified as prototype testers.

Data Analysis Procedures

I began the data analysis by reading through all of the documents and sorting them by the kind of document and the source of the document. Next, all of the documents were read again, and the coding process began. I analyzed the documents using open coding from the beginning, because open coding is the process that leads to the development of a formal theory that was the goal of this research. The data were analyzed according to Strauss's (1987) guidelines to open coding, beginning with asking questions. To what study are these data pertinent? What category does this incident indicate? What is actually happening in the data? Next, the data were analyzed minutely line by line. Coding was frequently interrupted to write a memo. I did not assume the analytic relevance of any fact sheet or traditional variable until it emerged as relevant.

The process of coding is extremely important to the grounded theory method. Inductive researchers do not pre-code datum until it is collected and its function within the context is determined. I used the process of coding to create generative questions, to help me fracture the data, to lead to the discovery of core categories, and ultimately to help me move toward the integration of the entire analysis.

Core categories were chosen following Strauss's (1987) guiding principles. A core category should be central to the other categories; it should appear frequently; and it

should easily relate to other categories. Strauss (1987) also pointed out that core categories should provide clear implications for more general theory, emerge in theory as the details are worked out, and allow for maximum variation.

As I studied the TLWL project documents, I coded them based on criteria that emerged. The documents were reexamined repeatedly as long as new criteria for coding became apparent. I then categorized the data according to the emergent criteria. After this process was completed, I created a spreadsheet for each set of documents. Column headings in the spreadsheets included the document phrase and a column for each code category and subcategory.

I sorted the columns using different hierarchical choices. I continued changing the sorting preferences until patterns appeared in the data. I then checked other documents to see if the same patterns applied. For each set of documents, I continued checking for patterns and then comparing the other documents for the same patterns. When I finished testing all of the documents and could find no new patterns, I organized the documents and patterns for comparison and analysis. During the entire process, I kept a memo journal with thoughts, ideas, sketches, questions, and conclusions. Throughout the analysis of the data, I referred back to the memos. This kept me focused and helped me generate ideas as I progressed through the study.

Many of the data were displayed in a graphical form for easier interpretation. A context chart provided information about the development team. This chart was a network mapping in graphic form that showed the interrelationships among the roles. The different stages of the product were graphically represented using an event listing (Miles & Huberman, 1994). This matrix arranged the series of concrete events chronologically

while sorting them into several categories. The development of ADAM (activities designed around multimedia), the multimedia tool, was illustrated using an event flow network (Miles & Huberman, 1994). Selected major events, along with short explanations of their connections, described graphically how the process of development flowed from one event to the next. Major events were placed in a critical event matrix. This chart provided a quick look at important TLWL activities.

The process of analyzing these data closely followed the outline suggested by Strauss (1987). As the progression of coding occurred, generative questions were formulated. Through analysis of the coding, generative questioning, memoing, and graphical layout, I created linkages among the discovered concepts. Next was the issue of integration. This was when the core of the evolving theory began to emerge. Theoretical memos were a critical component in keeping track of all the nascent ideas.

I kept myself immersed in the data during the entire analysis process, constantly comparing the RDD, evaluation, and system models discussed in the literature in chapter 2 to the data gathered during this project. Throughout the study, I developed feedback models and compared charts to determine emerging patterns..

Methods for Verification

The results of this study were analyzed using triangulation. Denzin (1978) defined triangulation by (a) data source such as persons, times, or places; (b) method such as observation, interview, or documents; and (c) theory. Miles and Huberman (1994) added data type, such as quantitative, texts recordings, or qualitative. All four of these definitions were appropriate to this study as different data sources, methods, theories, and data types were collected for evaluation.

Another way I verified the research analysis was by checking for representativeness (Miles & Huberman, 1994). A constant comparison was made between groups of data to determine that analogous data had similar characteristics.

Checking for researcher effects was also included in the verification process. Miles and Huberman (1994) suggested continuously thinking conceptually by translating personal thoughts into more theoretical ones. This was accomplished through memoing. Finally, I kept the research questions firmly in mind, thus keeping focused on the overall picture.

CHAPTER 4

DATA ANALYSIS

This study was based on data gathered from a single case study of the Technology Leadership Web Library (TLWL). The TLWL was one of three components comprising the Technology Leadership Institute (TLI) federal grant project. The Texas Center for Educational Technology (TCET) was the principal grantee. During the 3 years of the project, I held three positions. First, I was a curriculum specialist, and then I became the TLWL half-time team manager. Finally, I became the full-time team manager. My jobs in the project facilitated my ability to gain access to all of the project records. I gathered files, reports, minutes of meetings, and email communications from all 3 years of the TLWL project for this research.

This research was focused on determining factors that impact development and diffusion of multimedia materials for education and analyzing the role that feedback plays in the development and diffusion processes. I used the grounded theory approach of open coding to determine patterns formed by the data that could lead to answering the research questions and forming a generalized theory.

Preliminary Data Organization

I began researching the project by reading and sorting all of the documents obtained. After scrutinizing each document, I was able to eliminate half of them as duplicates. Each of the original and hand-written documents was kept. The next step in organizing the data was to separate the files into categories. I chose to use categories that

defined the type of data found in the document. The file divisions were minutes, reports, surveys, feedback, and email. I then subdivided these files by considering the source of the document. Sources included TLI project manager, TLWL manager, team members, evaluator, focus group, faculty advisors, prototype tester, and user groups. The user groups were later divided into beta test groups and consumers.

After creating the categorized files, I began the case study analysis by reading the minutes of the weekly team meetings several times. From the minutes, I was able to gather facts about what was happening, dates on which the events occurred, who was responsible, and decisions made. I was also able to draw inference from the meeting documents that suggested problem areas, confusion, hope, and excitement. I verified the speculative analysis by triangulating the results with other case study documentation, including email correspondence and reports.

After sorting and coding, I divided the data analysis reported in this chapter into three major categories: weekly team meeting minutes, group feedback, and feedback from individuals. This is outlined in Table 4, along with the useful information gathered from the analysis of each subcategory. The information in the Table 4 provides a brief summary of data analysis.

Table 4

Outline of Chapter Data Analysis

Category and subcategories	Information gathered
Weekly Meeting Minutes.....	
Significant Events	These data provided information leading to a determination of factors important to product development and dissemination.
Monthly Progress	
Team Feedback Loops	
Attributes of Major Events	
Leadership and Team Dynamics	
Group Feedback	
eSchool	Evaluate questionnaire usefulness
Focus Group 2000	Determine faculty characteristics
TCET Symposium 2000	Evaluate questionnaire usefulness
Student Feedback	Evaluate questionnaire usefulness
Houston Teacher Product Testing	Identify user needs
Focus Group 2001	Identify user needs
Pilot Faculty Workshop	Test workshop functionality
PageMaker Tutorial Workshop	Identify user needs
TCET Symposium 2002	Product use and adaptation

(table continues)

Table 4 (*continued*)

Category and subcategories	Information gathered
Feedback from individuals.....	
Communication between team members	Development of team dynamics
Faculty advisor feedback	Expert guidance
	Faculty characteristics
Prototype tester feedback	Tester characteristics
	Feedback content
Consumer feedback	User feedback evaluation

Minutes From the Team Meetings

Significant Events

The staff members of the TLWL documented their weekly meetings with detailed minutes. The recorder of the minutes changed weekly and thus provided a variety of perspectives. I did a line-by-line coding (Strauss, 1987) of these minutes. After finishing this process, I chose to reread the minutes in search of major events rather than to look for code patterns. I made this choice in an effort to reduce data bias by examining the data from multiple perspectives before identifying relationships for analysis. After reducing the events to include only those I thought were major to project development, I was able to generate the Critical Incident Chart found in Table 5. Only the most significant events for each month were chosen. The incidents were then sorted by date and the general topics of module development and team events. These topics reflected

those generally discussed in the meetings. When the chart was finished, I selected the events that manifested significant progress or change in direction of the project, as suggested in Miles and Huberman (1994). These events were identified by placing a black box around each one as it occurred in the Table 5.

Table 5

Critical Incident Chart for TLWL

Date	Product development	Team events
9/1999	First TLWL meeting. Met with master teachers.	
10/1999	Scripted and videoed the first module.	
12/1999	Major search for existing video footage. Prepared Web site mockup	TCET Symposium
2/2000	Cannot find direction for the project. Worked on alternative to eSchool.	TCEA
4/2000	eSchool was up and running.	½ time Web Library manager identified. Outline process for developing a module.
5/2000	Technical problems with eSchool. Web site redesigned	
7/2000	Flyers replaced curriculum notebooks.	
9/2000		TL Academy Fall Institute.
10/2000	Obtain many videos.	Conceptualization of the TLWL team. Manager goes full time.
11/2000	eSchool was replaced with ADAM. New site up with purple banner.	

(table continues)

Table 5 (*continued*)

Date	Product development	Team events
1/2001		Formed collaborative with other groups. TCET Symposium
2/2001	Downloadable zip file available.	
4/2001	Converted video to lower bandwidth. First CFB module posted.	
6/2001	Order form and evaluation posted.	Faculty Pilot Workshop
7/2001	Video broken into sections.	
8/2001	Reduced ADAM size.	
9/2001	5020 modules created. FAQs aand Search pages posted	Each member will be part of the final editing process.
10/2001	State of TX SC*RTEC module posted. Created a support folder for sharing.	Focus turns to commercializing product.
11/2001	Supporting Material became Resources	
12/2001	Began redesign of web site.	
2/2002	Put new logo on modules. Shortened file names to accommodate Mac users.	
3/2002	Created PageMaker tutorial using Director.	Pilot workshop for tutorial.
4/2002		Lost two major team members.
7/2002	2nd tutorial posted. New Web site up. Free Media menu created.	Two new team members.

Note. Cells that are marked with a black rectangle represent significant events.

Monthly Progress

As I read and interpreted the minutes from the TLWL meetings, I assigned each month a rank. This integer represented my analysis of the progress made toward achieving the project goals. Progress was determined as a plus one for modest progress or a plus two for dramatic progress. Progress could be an innovation or major step toward a goal. I excluded using the number of multimedia products completed as an indicator of progress, because there was no clear documentation of the exact completion dates. If the status quo was maintained for the month, then the score did not increase. The completion of scheduled events and routine product development was considered a status quo. During stages of disruption such as redefining the project vision and replacement of goals, I subtracted one from the previous progress score. This analysis provided me with a graph for visual interpretation of the data. These data are found in Figure 1.

I chose five points as significant because they are located at junctions of pattern changes in the graph. According to the graph, the first sign of sustainable gain was March-April 2000. In September there was a drop followed by another increase. The rate of gain doubled in January 2001 and then leveled, with no gain between April and November 2001. The graph shows a stair-step increase from November 2001 until August 2002. I considered Point 1 significant, as it was the first TLWL event. Point 2 is located at the end of the sawtooth pattern and the beginning of the first 2-month gain. After this gain, the score did not drop back to zero as before, but it did drop. Another change is visible at Point 3, where the drop in the graph is followed by 5 months of continuous increase. At Point 4 the angle of the sloped line changes from 1 to 2. The change is an indication that something significant occurred in the project. Point 5 is the

junction between 7 months of no change and the first of three steps of positive change. A comparison of Figure 1 with Table 5 supports the selection decisions of significant points of change in Figure 1. There is an agreement between dates of the selected points on Figure 1 and the highlighted events in Table 5. This analysis provided me with time segments to examine so that I could isolate events and identify them as having significant positive or negative impact on the project. Later in this chapter I will discuss the actions that occurred in the project during each significant period highlighted by the graph in Figure 1.

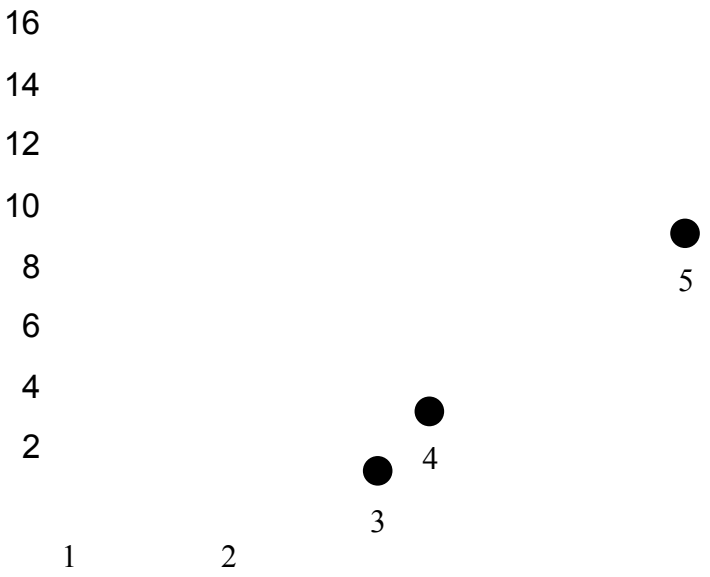

Figure 1. *TLWL monthly progress indicating significant points of change.*

Note. The tic marks on the x-axis represent month intervals beginning September 1999. The y-axis is an arbitrary scale representing the progress ranking scheme.

Identification of Codes

Next, I reexamined the coded minutes. I labeled the major categories that emerged as *feedback loop*, *nature of communication*, and *focus of communication*. Feedback loop codes identified the source and recipient of communication. Figure 2 shows a diagram of the feedback that I determined from the data occurred in this case study. I also coded the feedback according to whether it was positive, negative, constructive, directive, informative, or suggestive. The label for this category is *nature of communication*. The subcategories for the topics of the Focus of Communication are listed and explained in Table 6.

Feedback Loops. As part of the coding process, I identified the source and recipient of all recorded communication. A diagram showing the results of the feedback connections is illustrated in Figure 2. Just because I indicate a feedback connection, I do not assume that the connection was successful or productive. During the first 6 months of the project, the team manager position did not exist, so all of those connections were absent. The project manager, who managed the entire TLI, and the project director, who was the principal investigator for TLI, communicated directly with individual team members. The team received no feedback from the focus group in the first 6 months. Prototype testers also communicated directly with team members.

During the period of management by a half-time team manager, the feedback connections between project manager and project director and team members were still present. When the team manager became a full-time position, the feedback connections between the project manager and project director were linked, with the team manager acting as a liaison between most feedback sources and the team member recipients.

Exceptions to this were communications with faculty advisors and prototype testers. As the TLWL progressed and the team manager and team members began to function effectively with one another, the project manager and project directors no longer worked directly with team members. Instead, feedback loops developed with the team manager, who reported communications to the team.

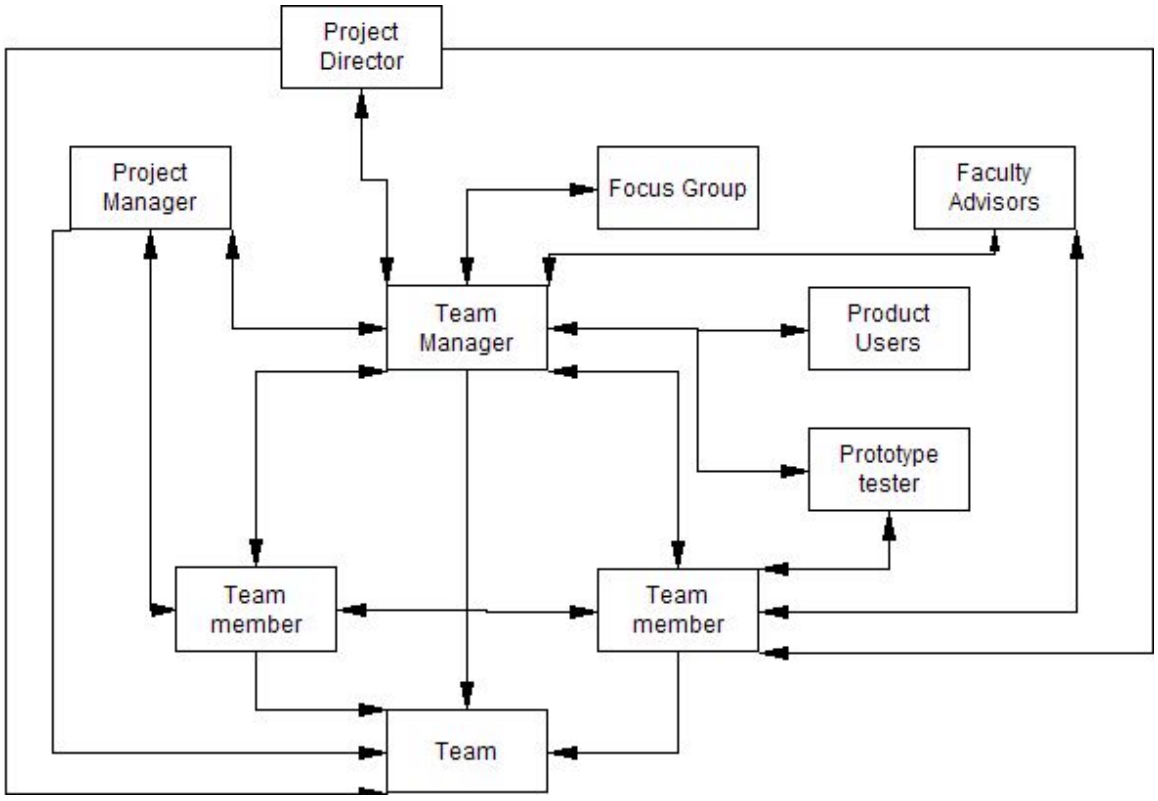

Figure 2. *Generalized Feedback Loops Indicating all Communication Surrounding the Team.*

Note. The arrows indicate the direction of communication from source to recipient.

After analyzing the feedback networks shown in Figure 2, I grouped the components into two concentric circles, drawn in Figure 3. The inside circle contains groups and individuals involved with the product development. The outside circle contains the individuals and groups that provided feedback to the development team. Although the faculty advisors and focus group were not part of the main development team, their contributions to the product occurred during the development process. They provided expert advice that was central to the initial product development, thus, the focus group and faculty advisors belong in the center circle. The outside circle includes the users and prototype testers. I divided the users into two groups: beta testers and consumers. This division was important, because beta test groups piloted the product before the final version and then consumers used the final product. The two groups provided different kinds of feedback, as discussed in the sections on feedback.

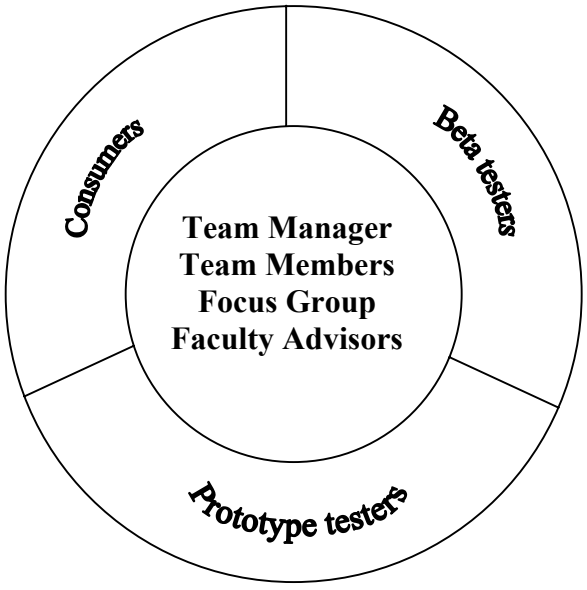

Figure 3. *Interpretation of team dynamics as persons inside the team and persons outside the team who work with the inside team.*

Nature of Communication. I found that the feedback data naturally divided into a category I labeled *nature of communication*. The nature of the feedback subcategories included positive, negative, constructive, directive, informative, or suggestive. Positive, negative, and constructive feedback generally came from the outer circle of Figure 3, which included the prototype testers and beta testers. The consumers provided informative feedback and suggestive feedback. Feedback generated within the circle was directive, informative, constructive, and suggestive.

Focus of Communication. Topics of feedback sorted into a category I titled *focus of communication*. Table 6 contains a list of the topics in this category. These topics were important to the analysis, because different feedback focused on different topics. This helped me determine what topics were important and were most productively addressed by each group.

Table 6

Coding Interpretation for the Focus of Communication

Focus	Explanation
Technical design of product	The way the technology components worked together
Content design of product	How the content pieces were arranged
Curriculum issues	Use of the product in teaching
Dissemination of product	Distribution to the consumer
Protocol form	Charts and tables indicating how things were done
Team development	How the team members worked together
Delivery	Format for distributing the product

(table continues)

Table 6 (*continued*)

Focus	Explanation
Slide	Content segment of ADAM
Video	Segment of ADAM
Web site	Technology Leadership Web Library online
Technology issues	Making the product function properly for everyone
Editing	Testing content and technology for errors
Vision	A direction for the project
Progress	Steps toward meeting the project goals

Attributes of Major Events

Next, I synthesized the information in Tables 5 and 6 and Figures 1-3. I determined dates, significant events, and the circumstances involving the decision-making processes during each event. From the blended data, I produced Table 7. Table 7 splits the stages of development in the TLWL project and identifies them by stage, major event, and attributes that uniquely characterize each stage. I used the patterns developed from the coding, along with my personal knowledge of each occurrence, to provide a subjective interpretation for comments in the attributes column. I also included a listing of 3 months in 2000 when the team manager was out of town. The data during these times were significant in understanding the role of leadership in the project. These data reflect the only times during the entire project in which no meeting documentation was available. The explanation for the lack of documentation is that there were no weekly team meetings during these months. The simultaneous occurrence of the team manager's

absence and no team meetings provides important insight into the significance of team leadership and team dynamics.

Table 7

Attributes of Major Events that Characterize the Five Stages

Dates	Event	Attribute
Stage 1 10/1/1999 through 3/31/2000	Staff held first meeting of the TLWL when they met with master teachers to develop modules in eSchool format.	Make several attempts to create a project vision. Make several attempts to identify the meaning of the project goals as outlined in the grant proposal. Provide job descriptions. Struggle to find video resources. Directive feedback comes from multiple sources. Create very few products.
Stage 2 4/1/2000 through 9/30/2000	A TLWL Team Manager is identified.	Schedule weekly meetings of the entire TLWL staff. Create protocol forms for various kinds of feedback. Organization of meetings is obvious. Format for product development is established. Focus to create product following Rogers's 5 Attributes.

(table continues)

Table 7 (*continued*)

Dates	Event	Attribute
6/2000 8/2000 9/2000	Team manager is absent.	No team-meeting minutes exist. Email correspondence indicates many problems with eSchool. Continue to create modules.
Stage 3 10/1/2000 through 12/31/2000	Team manager is hired full time.	Establish new TLWL team. Replace eSchool with ADAM. Develop new Web site. Examine product delivery modes. Graphics and design emerge as important components. Team coalesces. Feedback is vital component.
Stage 4 1/1/2001 through 9/30/2001	Collaborative partners join with TLWL team to create products.	Several staff members go full time. Refine product development process. Make quality control top priority. Team dynamics improve. Fine-tuned ADAM. CD dissemination increases. Presentations, workshops, and exhibits are routine events. Solve major delivery issues.

(table continues)

Table 7 (*continued*)

Stage 5 10/1/2001 through 7/31/2002	Primary focus changes from ADAM to the TLWL Web site.	Team manager returns after one-month absence. Develop promotional items to aid product dissemination. Divide TLWL staff into design and product teams. Web site undergoes significant changes. Replace several team members with new staff. Update earlier product. Create a new module using Director Software. Add different kinds of media to Web site resources. Create all new logos.

Leadership and Team Dynamics Developed During Stages 1-5

As I examined the data provided through the minutes of the weekly team meetings, I noticed emerging patterns of communication and decision-making. I found that the patterns had a correlation with the five significant stages of the project.

Stage 1: Muddle. Figure 1 and Table 7 indicate the TLWL experienced difficulties during Stage 1. Analysis of the coded documents of the meetings provided information about feedback loops during this time. The data provide evidence that there was no clear leadership or shared vision at the beginning of the project. Directive feedback came from the project director, project manager, and three faculty advisors. The directives were given to individual team members, as shown in Figure 4. Vision and

goals were redefined by a different person each meeting. Member comments recorded in the documents indicate that team members were confused about the project and the leaders' expectations of them. Meeting notes were filled with question marks, and at one point the question is asked, "Who's doing the driving?"

Although I refer to the TLWL staff as a team, during Stage 1 there is no indication that members were working together toward a single goal. The meetings minutes refer to the different staff members and their job descriptions, but the minutes do not refer to task completion or workflow. There were only two meetings during Stage 1 when the majority of the staff attended. The other meetings involved two or three staff members meeting and making decisions. Only 5 of the 40 directives discussed in the meetings' documents resulted in action taken.

In summary, Stage 1 was characterized by a lack of leadership and team development. Focus was on trying to find direction and resources. Each person involved in the project worked in isolation with no feedback from other team members.

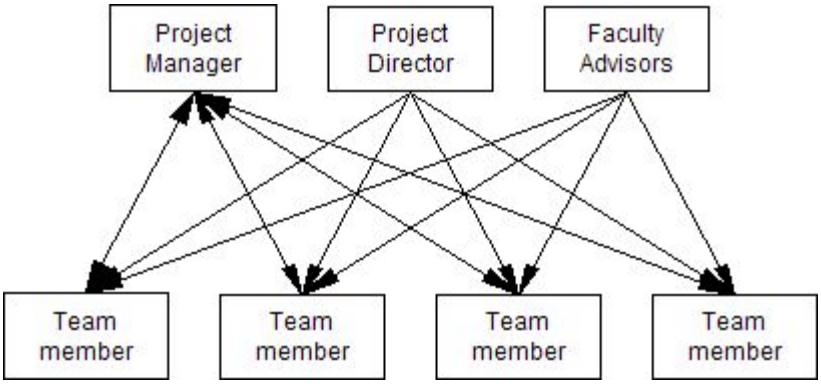

Figure 4. *Feedback loops developed during first six month of the TLWL project.*

Stage 2: Resources and Direction. The wording of the meetings' minutes during Stage 2 was different from the language used in minutes from the previous stage. At the beginning of this stage, I was appointed TLWL team manager. The weekly team meetings became mandatory. The meeting organization included an agenda outlining the discussion topics. During Stage 2, much of the feedback from me as the team manager was directive in nature as I tried to pull the team together and provide guidance for those who were unsure of their job responsibilities. I defined goals and described my vision in an effort to create a shared vision within the team. I held the half-time position of TLWL team manager during the time I held that I a half-time position on another curriculum project. I directed most of my efforts during Stage 2 toward finishing the curriculum project. As a result, the team solidarity and functionality suffered, particularly during my 3-month absence.

During my absence, the team continued to work on developing the eSchool modules, but it did not hold any team meetings. There were many email correspondences between team members and the eSchool programmers trying to correct authoring and delivery problems. These written communiqués express members' increasing irritation with product development. The team members created 19 modules accessed through the eSchool file server, but they were never able to develop a Web site capable of delivering these modules online.

Emergent leadership and an attempt at team development characterized Stage 2. The team manager provided a basic product development protocol for team members in an effort to aid in the design and development of the product. The protocol was also designed to help the team begin to work together. The formulation of a production

process and the acquisition of adequate video resources were sufficient for team members to create products during the team manager's absence. No evidence, however, of any development of team dynamics was detectible at Stage 2.

Stage 3: Vision. At the beginning of Stage 3, I became the full-time TLWL team manager. I spent much of the summer during my absence in the second stage developing a new approach for the project. These ideas were shared with the team at the beginning of Stage 3. During Stage 2, I worked with the TLWL programmer to refine an alternate product to eSchool called Alternative Delivery of All Modules (ADAM). The two of us custom designed the new product to meet the educational needs expressed by faculty members. In anticipation of the need for new project staff people to develop the innovative product, I designed a team concept and hired six new team members. The first time the entire team assembled for the weekly meeting, the experienced team members expressed both surprise and excitement. I shared my vision with the staff members. The members agreed with the new concepts, and the written minutes provide evidence that, over the following weeks, the team developed a shared vision.

The feedback loop changed during Stage 3. The team manager became the source of all directive feedback to the team. There was no feedback from any source to an individual team member during team meetings. Figure 5 diagrams the evolved feedback loops. The replacement of eSchool with ADAM provided the TLWL team with the dual opportunity to discard any remnants of confusion lingering from Stages 1 and 2 and to develop new team dynamics appropriate for creation of the new product.

During Stage 3, I used my expertise as a change agent and my role as team manager to help the team build the product focused on the end user. I collected

information from faculty advisors, used feedback from the focus group, and investigated the literature to determine faculty characteristics that would foster the adoption of the TLWL products. I also researched the literature to find models for product dissemination and adoption. I shared this information with the team members. The minutes from those meetings and subsequent email correspondence reflected a shift in focus away from the product characteristics and more toward the user characteristics as team members discussed good design in terms of users, not technology.

Leadership and team loyalty characterized Stage 3. Two directional feedback loops provided communication links between team members and with the team manager. The development of new products, along with the addition of new team members, provided a fresh start for the project.

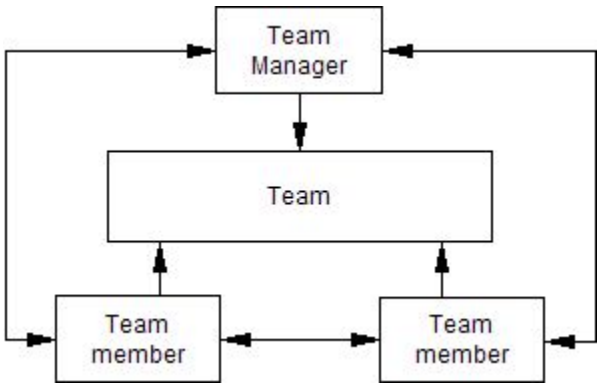

Figure 5. *Simplified team feedback loops developed during stage 3.*

Stage 4: Collaboration. During Stage 4, the team programmers, designers, and curriculum specialists continued to develop and to refine ADAM. Product development protocols that included built-in product-quality controls provided team members with

continuous feedback and shortened production time, according to production reports submitted by team members. Team members increased their job skills and needed less guidance, as evidenced by communication from the team manager's taking on a less directive nature. Educational groups noticed the improved quality of the product and contacted the TLI staff by email and telephone to express their favorable impressions. Four of these groups chose to collaborate with the TLWL team for producing products that would benefit both sides. Because of this collaboration, as team manager I adapted the product production process to include work flowing from both inside and outside the TLWL project team. Product production continued smoothly, with the only measurable change being a tremendous jump in product use as indicated by Web statistics and CD-ROM production. Both experienced an increase by a factor of five. Members of the collaborating organization provided an automatic consumer group of the product and had a positive affect upon product dissemination. Feedback loops were added to encourage communication between the TLWL team and the new collaborative development groups (see Figure 6).

Stage 4 represents the formation of collaborative agreements, collaborative development of products, and product use by the collaborative groups. The TLWL leadership factor was exemplified by the creation of new protocols that allowed for an efficient shift in the feedback network as outside information and product were assimilated into the team's existing workflow process. The team manager provided fewer directives to the team because inspired team members generated many of the new ideas and increased suggestive feedback, as documented in the meeting minutes. Job competency increased as team members continued to study and take workshops to

enhance their job skills and knowledge. Minutes for meetings and email correspondence indicated that team members' interactions with experts in their fields increased in both quantity and quality to higher levels than during previous stages. One member commented that faculty advisors were beginning to approach him to help answer their programming questions.

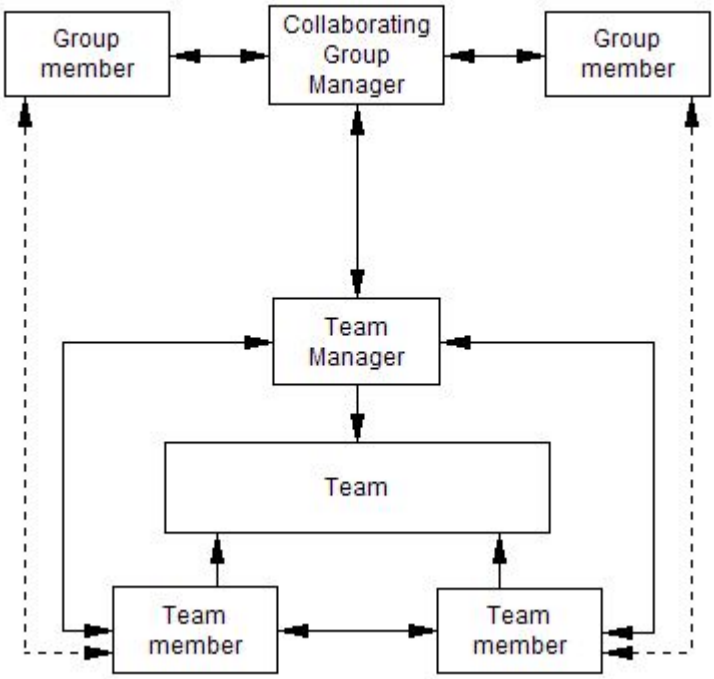

Figure 6. *Feedback between TLWL team and collaborative group.*

Note. The dashed lines indicate feedback limited by protocol.

Stage 5: Commercialization. As dissemination increased during the fourth stage, I realized, as team manager, that product and publicity needed an aesthetic makeover. I discussed this with the team, as recorded in the minutes, and they responded with constructive ideas of ways to make improvements. After several months of creating products using the same procedure, they were "in a rut" (quoted from the meeting minutes), ready, and eager to be involved in change. Three of the team members had graduated and moved to jobs outside the university. One of the part-time people became full time, and two new team members were hired. The change in focus and the change in

personnel resulted in a period of readjustment as the team manager's feedback became mostly directive for 4 weeks. The strength of the team prevailed, however, thus preventing the project from regressing. The new team members brought with them new knowledge and skills. They were not constrained by familiarity with the established methodology, and the suggestive feedback recorded in the minutes presented new ideas for the products and publicity. This stage of the project included the development of new products and new Web site pages that resulted in periods of growth, leveling off, and growth again, as indicated in Figure 1. Promotional gimmicks were explored and a mini-CD was created and disseminated.

Data reveal that during Stage 5 the team manager provided more directive feedback. They also indicate that communication between new team members and existing team members was infrequent at first as new team members looked to the team manager for direction. As the new team members appeared to adjust to their new positions, communication increased, and directive feedback decreased according to the written meeting minutes.

In summary, the TLWL project team refocused and turned its concentration to commercializing the product during Stage 5. An overhaul of the online Web Library changed the look and function of the Web site. Promotional materials were created. New team members brought diverse skills to the team, and the team created new products using different technologies. New team members also caused a temporary change in team dynamics. Once they became familiar with the team concept and expectations, the feedback network was reestablished.

Figure 7 illustrates the topical focus of the TLWL weekly meetings documented by the minutes. The chart is divided into 3-month periods and the stages have been identified for comparison. From the chart, it is apparent that issues involving resources were solved at the beginning of Stage 4, or the collaborative stage. The project seemed to go through periodic redefining, occurring in Stages 1, 3, and 5. Team development, product development and refinement, delivery, and evaluation were ongoing through the project, with times when they were not emphasized by the team. Protocol forms that established the functioning processes of the team were not mentioned in the minutes after the first part of Stage 5. Collaboration and publicity began to be a focus in Stage 4.

Figure 7. *Quarterly TLWL event occurrence record*.

Note. The marked segments represent 3-month periods identified at the bottom of the figure. The corresponding stages have also been identified for reference.

Chronological Account of Group Feedback

In this section, I discuss the feedback received and analyzed from identified groups. I call this *group feedback*. This is in contrast with the feedback I call *individual*

feedback, which is analyzed on an individual basis. Group feedback does not have greater significance than individual feedback, and it does not necessarily have a greater impact on the project.

The results of my analysis of the group feedback are discussed in chronological order. I also compare feedback data results during the significant stages discussed in the previous sections of this chapter. Some of the feedback generated from the groups provided information about the groups, some about the products, and some about the feedback instruments.

I identified three specific feedback groups. First was the focus group. This group was represented by professional educators assigned the task of providing periodic feedback to the TLWL. The second group was the beta test group. These groups embodied the same characteristics as the consumer groups, but each group was singled out to test the product and to provide feedback to the TLWL. These groups tested the product before its final release as a finished product. The third group is the consumer group. These groups provided feedback about the final product. Although I categorize consumers as groups, they are actually individual users, and I treated the feedback that way. The reason I put them into the group category is that the data were collected during conferences and workshops through questionnaires and surveys in sets. Thus, it was appropriate to discuss the results as groups. Figure 8 chronologically displays the group feedback discussed in this chapter.

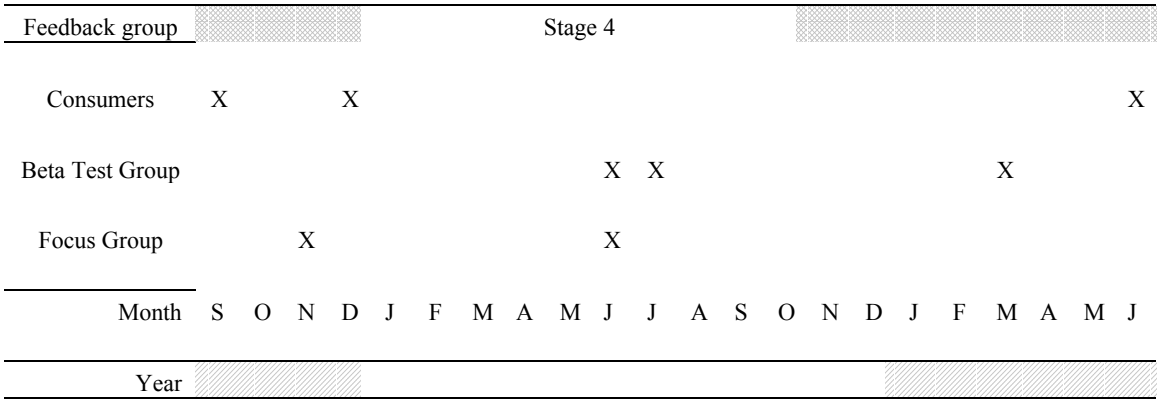

Figure 8. *Monthly Chronological Display of Categorized Group Feedback*.

Note. The chart is truncated, thus excluding months in 1999 January through August 2000 and July through August 2002. There were no data for these months. The stages of project development have been included for reference.

Feedback on eSchool Product

In September 2000 faculty members recognized as educational leaders met at the University of Texas in Austin for the first of three annual Technology Leadership Academy Fall Symposiums. The TLWL staff presented a 3-hour workshop during which the faculty members were introduced to the eSchool multimedia modules and were allowed to explore content and capabilities of the product. Each faculty member received a feedback questionnaire at the beginning of the workshop. The questionnaire consisted of four questions meant to collect consumer use data.

Question 1 asked the personal skill level of the faculty member. He or she had the choices of beginner, intermediate or advanced. Some members chose to circle the space

between two skill levels. Although this feedback was interesting, it provided no useful information. Faculty members ranged from *beginner* to *advanced* as was expected.

The second question asked for a yes or no response to the usefulness of the product. Every faculty member gave a positive response. Again, this question provided no useful feedback. The third question also required a yes or no response. Faculty members were asked about their willingness to assess future modules. All but one responded positively and information was organized in a database for later use as a contact list. Neither question two nor question three provided useful information for the TLWL product development or dissemination.

Question 4 was the only open-ended question. Faculty members responded with comments and suggestions about the product. Although the eSchool product was discarded a month after the workshop, answers to the fourth question were useful to analysis in this research. Responses fell into the categories: curriculum content, content design of the product, and technical design of the product. I discovered from the data that the comments about the curriculum content focused on the relevancy to the individual's teaching. For example, one response suggested creating a module involving literacy assessment. Comments concerning both content design, such as building more "pause points" into the module, and technical design, such as increasing the size of the video window, focused on the faculty member's ability to control the product during use or enhance the user-friendliness of the product. The information that I gathered from question four provided insight into the kinds of feedback that were useful during product development.

Unedited Feedback from Focus Group

Built into the project grant proposal was the requisite that a committee of educators referred to as the focus group would meet regularly and provide feedback to members of the project. The meetings transpired under the guidance of the project evaluator who then edited the feedback for clarity and presented it to the project and team managers. I obtained a transcript from the original audiotape of the meeting on November 2000 and used it in this research. The document was a rich resource for analysis, because it consisted of the unedited words of seven educators candidly discussing the project.

At the time of the meeting, the new multimedia format called ADAM (Activities Designed Around Multimedia) was just developed. The name was changed at the beginning of Stage 3, because it was no longer an alternative delivery tool. The project evaluator demonstrated ADAM to the focus group, who then discussed the different aspects of the product. Evaluating the feedback, I performed a line-by-line coding of the discussion. From this analysis, I was able to determine that the focus group discussed each of the topics listed in Table 6. The constructive feedback concerning each of these topics was later discussed in the team meetings, as documented in the minutes. Comparing these suggestions with identified TLWL changes, I was able to determine that all the suggestions were acted upon and eventually were incorporated into the project or product.

From another analysis of the feedback from the focus group, I deduced that 10 characteristics of faculty members seemed to drive the comments made by the focus group members. These characteristics agreed with the faculty characteristics identified in Table 2. I listed the 10 characteristics observed in this study in Table 8, along with the

percentage of comments that reflected each. The percentage was included to indicate the influence of each characteristic on the feedback comments. The team used this information to guide the design of the product and thus make it more appealing to the faculty member user.

Table 8

Faculty Characteristics Reflected in Focus Group Feedback

Characteristics of faculty members	%
They are looking for relative advantage to teaching and learning in the new product.	21
They are relevancy oriented.	13
They prefer step-by-step examples.	12
Their primary interest is teaching and learning.	12
They are reflective practitioners looking for worth in the new tool.	10
They have a need to control and manage their environment.	8
They foster critical and reflective thinking.	6
They have a low tolerance for things that don't work, things that are complicated, or things that they don't like.	6
They have an enthusiasm for promoting technology.	6
They are self-directed learners.	6

Note. The sum of the percentages equals 100%.

The 10 faculty member characteristics concentrated on in the focus group feedback and Rogers's Five Attributes (Rogers, 1995) became guidelines for product development beginning in the third stage of the project. Team members discussed these guidelines when considering refining the product design and dissemination, as documented in meeting minutes and email correspondence.

In summary, the feedback from the November 2000 meeting of the focus group provided useful information to the TLWL team about user characteristics and constructive comments on product design. From the feedback, the team was able to improve the product design and dissemination. The team used constructive comments to focus on individual aspects of the projects. The insight into important faculty member characteristics gave the team a broader view of important attributes that the product should encompass.

TCET Symposium 2000 Feedback

Each year the Texas Center for Educational Technology (TCET), part of the University of North Texas Education Department, hosts a symposium in San Antonio, Texas. TCET was the principal partner in the TLI grant project. During the 2000 Symposium, 40 faculty members attended a 3-hour presentation of the TLWL Web site and ADAM. At the conclusion of the presentation, they completed a questionnaire designed by TLWL staff to ascertain whether the faculty members liked the products and what aspects of the products faculty members would like to see changed. Feedback was meant to augment consumer use information.

The questionnaire was not well designed. The questions were confusing, and answers were inconsistent. After being unable to gather comprehensible data from the

questionnaire, I decided to analyze the questionnaire itself. I was interested in learning what kinds of information would have been useful for the TLWL team and what this feedback instrument lacked. For each question, I interpreted the focus of communication and the type of question format (see Table 6). The data from the questionnaire are listed in Table 9.

Table 9

TCET Symposium 2000 Questionnaire Data

Focus of communication	No. of questions	Question format	No. of type
Content design of product	11	Likert scale	5
		Yes or No	6
Technical design of product	3	Likert scale	3
Video	2	Likert scale	2
Slides	1	Likert scale	1
Web site	1	Open-ended	1
Curriculum content	1	Multiple choice	1
Delivery system	1	Multiple choice	1

Examining the entries in Table 9, I determined that all of the questions asked had a very limited answer selection with the exception of the question concerning the Web

site. Answers to all of the questions spread across the range of accepted responses. Thirty-two of the 40 respondents indicated they had a favorable opinion of the products, and 8 of the respondents chose to remain neutral. Though these answers were collected, the reasons behind the faculty members' decisions were not available. As a result, no information about what was right or what was wrong with the product was generated through the questionnaire.

The question concerning the Web site did yield comments. None of the comments, however, was related to the Web site. Comments included "shorten the video" and "provide shared practices." It seems that because this was the only space on the questionnaire where the faculty members could express themselves, they made use of that space for a variety of comments. These comments were out of context and were not constructive feedback for the development of project.

Student Feedback About the TLWL Products

During December 2000, the same questionnaire put forward to the TCET Symposium participants was distributed to six educational methods classes on two college campuses. The results of the questionnaire were the same as for the previous group except all of the responses were positive concerning the attitudes toward the products. Though this information did not provide the team with suggestive guidance to improve the product, it did provide encouragement for the TLWL team as noted in the minutes.

Product Testing Feedback From Teachers

In January 2001, the TLWL team was approached with the opportunity to work collaboratively with two separate groups on product development. One group was

working with online staff development; the other group was developing college curriculum for online delivery. The collaboration created a shift in development process dynamics and launched Stage 4 of the TLWL project. It also created a greater need for product quality control. Lastly, it provided the TLWL team with identifiable product testers outside the team members themselves.

One of the groups of product testers was in Houston, Texas. Ten teachers enrolled in a course at the University of North Texas. As part of their course requirements, they beta tested the product and submitted online evaluations of the TLWL products. The online survey was comprehensive and included 40 compound questions. An important detail to include at this point is that teachers received desktop computers as a part of their course. The computer specifications were not compatible with those needed to view the multimedia products. Teachers' frustrations were openly expressed and affected some of the feedback comments, resulting in a negative skewing of the data.

I chose to do a frequency count of code subcategories to analyze the data received from the Houston teachers. Table 10 lists the results of the frequency count. The survey questions were evenly divided between the topics listed in the left column of Table 10, yet teachers overwhelmingly commented on issues related to the content of the materials included in ADAM. As seen in the Table 10, of the 78 comments, 63 were about the content. The numbers in column 3 indicate that the teachers were most concerned with the product's relevancy to their teaching. These comments outnumbered the others combined by more than 2:1. There were many negative comments about the products. These included such statements such as "The type was too small" and "I didn't like the cartoon graphic." There were also many comments declaring that the technology "just

didn't work." Most of the negative comments, such as the first two examples, alluded to solutions and could be construed as constructive in nature.

Table 10

Results of the Houston Teachers' Comprehensive Online Survey

Focus of communication	No.	Nature of response	No.	User need	No.
Content material	63	Negative	44	Relevancy	54
Technical design	7				
Technology	5	Constructive	27	User friendly	12
Curriculum	1			Aesthetical value	7
Editing	1	Positive	7		
Video	1			Control	5

Note. The numbers represent the frequency of responses in each category.

Teachers responding to this survey were concerned with the content of the materials and the material's relevancy to their teaching. The technology, technical aspects of the product, and its user-friendliness were also discussed, but much less frequently.

The group of teachers was representative of the consumer group and as such made the content of their comments important to understanding the needs of the consumers. The survey provided insight into the importance of context and issues of relevancy in developing future surveys for beta testing.

Focus Group Feedback June 2001

Unlike the feedback in 2000, the feedback available concerning the meeting with the focus group in 2001 had edited content. As a result, I had the summaries of the discussions, but I did not have the context and spontaneous remarks to enhance my analysis.

Fifty percent of the discussion from the focus group dealt with the technical design of the product. The concerns about the technical design split evenly between user control of the product and user-friendliness of the product. In each case, the concern targeted a refinement of the product and not a change or overhaul of the product. All of the items discussed by the focus group were addressed and were implemented by the TLWL with the exception of one item. The suggestion that the video should automatically pause in certain places could not be implemented because it was not technologically possible at that time.

The abbreviated comments from the June 2001 meeting of the focus group pointed to the group's interest in refining the technical design of the product to make it more user-friendly and user-controllable. The nature of these comments was constructive and aimed at polishing the product rather than reconstructing it. After considering each comment, the TLWL succeeded in accomplishing all but one of the revisions.

Pilot Faculty Workshop

From the onset of the TLWL project, the intent was to develop and present workshops for faculty members as part of the multimedia dissemination process. During Stages 1 and 2 of the project, the workshop focus was on teaching educators to use the eSchool product effectively. Because there was no pedagogical aspect to that multimedia product, providing written materials and staff development opportunities were considered vital to the success of the project. Workshop design became a regular part of the discussions about product development. During these project stages, there was a failed effort at producing the written materials, and a workshop curriculum was never actually developed. The desire for faculty development workshops persisted, however. The majority of the workshop discussions were between the project director and the team manager. The Team Manager then reported to the team the gist of the discussions, and these summaries are recorded in the meeting minutes.

In Stage 3 of the project, when the new multimedia tool ADAM was developed, the focus of workshop content changed. The TLWL staff investigated several possible workshop topics, including pedagogy, faculty as change agents, and technology as a tool. In July 2001, a pilot workshop offered faculty members the opportunity to provide the TLWL staff with input as to effective approaches to staff development. Each of the three workshop topics was included in the workshop.

The 4-hour workshop began with a discussion on the uses of technology for teaching preservice teachers. The focus then turned to the faculty member's role as a change agent for the adoption of technology integration in education courses. Participants answered questions in a self-analysis tool that helped them determine their innovation

adoption type. Next, the workshop leaders presented different opportunities for faculty members to become involved in collaborative efforts for educational leaders. These collaborations were designed to allow educators to communicate with one another and to share issues concerning technology and teaching. Finally, the online resources, including ADAM, were introduced, and participants were allowed to explore the multimedia resources on their own.

At the conclusion of the workshop, participants were asked to complete an online questionnaire. There were 18 participants in the workshop. The results of the questionnaire are recorded in Table 11. Because of the variance of responses I entered the answer that reflected more than 60 % of the feedback for the question.

Table 11

Pilot Workshop Survey Questions and Responses

Questions included:	At least 60% responded as follows:
1. What part of workshop did you find thought provoking?	Discussion between participants.
2. Comment on Adoption Type Self Analysis.	(Critical of the tool.)
3. How will you use this material as a change agent?	(No relevant responses.)
4. What aspect of TLI most appeals to you?	Flexibility and resources.
5. What other aspects of TLI interest you?	(Varied.)

(table continues)

Table 11 (*continued*)

Questions included:	At least 60% responded as follows:
6. In which of the building collaboration programs will you participate?	(No relevant responses.)
7. How will the modeling of the module be useful for your own teaching?	(Varied.)
8. What improvements would you suggest?	(None)
9. Which section of this workshop is most useful to you?	Individual exploration of the modules.
10. Comments on changes that need to be made to the workshop.	(Varied.)
11. Overall impression and suggestions for improvement of future workshops.	(Varied.)

As seen in Table 11, questions 3 and 6 were answered by participants, but the responses either did not pertain to the question or indicated unwillingness by the participant to provide an answer at that time. Thus, I included this in the table as "no relevant responses." Examining the two questions, I realized that both questions required a degree of commitment on the part of the respondent. In question 3 the faculty member was expected to identify himself or herself as a change agent. In question 6 participants were expected to commit to an unfamiliar collaborative program. These were the only two questions that obligated participants and the only two questions that had responses that were evasive.

Questions 1, 4, and 9 had consistent responses. Faculty members indicated by their responses that they enjoyed time for exchanges with their colleagues. Faculty members liked to have resources that were adaptable to their needs and preferences. They also preferred to learn through hands-on experiences. I believe these responses indicated that the faculty members desired learning through self-direction and control of their environment, two faculty characteristics listed in Table 8.

Questions 5, 7, 10, and 11 had a variety of responses. The questions were open-ended with no parameters set for the responses. Because these answers expressed individual preferences, they provided no substantive information for the TLWL team. Question 2 did reflect a consensus of the faculty members' dislike for the Adoption Type tool, although the reasons for the negative reactions varied. The TLWL staff did not use the tool again in any workshop.

The faculty members did not respond to question 8 during the workshop. After the workshop, as the team manager and a workshop leader, I met with each one of the participants to talk about the workshop on a one-to-one basis. During these individual discussions, the faculty members provided many different ideas about the workshop and the products. In response to the individual feedback, the TLWL staff made several changes.

The title of the pilot workshop was Breaking the Cycle: Changing the Way Faculty Teach. I discovered through my discussion with the faculty that the title provoked some negative feelings, and thus the title became Tools for the Teacher's Teacher. After changing the title, I received correspondence from several educators from other institutions who did not attend the pilot workshop. The feedback reflected these

educators' preferences for the original title. I investigated the backgrounds of these educators and found that they were change agents and leaders at their colleges. I chose to keep the second title so that the workshop appeal would not be limited because of a controversial title.

The first section of the workshop, the part that covered change agents and adoption types, was omitted for future workshops. I discovered from the workshop questionnaire responses and discussion with participants that faculty members wanted to learn about the product and its relevance to their needs before recommending it to others. The focus of the workshop was unclear to the participants because the topics were not connected. Future workshops focused on the product and left out the other two topics on pedagogy and change agents.

Participants expressed interest in beginning the workshop with an overview of ADAM and then having the opportunity to explore it on their own. This concept was adopted and used in future workshops. The idea of presenting the product up front with little explanation also became the accepted practice for all TLWL presentations.

In the role of team manager, I believe that the most important outcome of the pilot workshop feedback was the StarPlanner, an online lesson development tool. Faculty members recommended an addition to the online products to provide a lesson guide to their use. This suggestion launched a design effort that resulted in a database-driven tool for lesson planning and guidance. Thus, feedback from the faculty user group generated the development of a new TLWL product.

Software Tutorial Workshop

One of the TLWL collaborative partners, who was added during Stage 4, acquired software from a large software company in January 2002. The partner did not have resources for teaching students to use the new software. The collaborative partner approached the TLWL staff with the request for tutorials and workshops over the new software. As the team manager, I discussed the new product needs with the partner and then worked with the TLWL team to select the technology and create the design that would meet the needs.

During February 2002, the TLWL team created a tool that was the fundamental component of a new Web Library product called the Athena Learning Series. A prototype for the product was developed and tested. By the beginning of March, the new product was ready for beta testing by teachers. I led a 4-hour workshop during which I presented the tutorial software module. The teachers' feedback is listed in Table 8. I collected the feedback while observing the teachers using the product and listening to their opinions. At the end of the workshop, the entire group discussed these opinions, and the comments in Table 12 reflect the consensus of the group. Consensus feedback was more useful information for the team than individual preferences during the beta testing of the product. This was indicated by the action taken on various feedback responses noted in meeting minutes and was compared with the feedback from the Houston teachers and the Pilot Faculty Workshop.

Table 12

Software Tutorial Workshop Comments and Analysis

Comment	Focus	User need
Would like to replay the segment.	Technical design	Control
Want a pause and play feature.	Technical design	Control
Want a volume control for video and for slide.	Technical design	Control
Would like to be able to adjust the size of the screen.	Technical design	Control
Need additional clarification of instruction in some sections.	Content design	User friendly

Four of the five conclusions indicated that the teachers wanted more control of the product involving product refinement of the technical design. Teachers also pointed out where a change of words would clarify the instruction, thus making the product easier to understand and use. The TLWL team made all five of the suggested changes in the final product.

TCET Symposium June 2002

The TLWL staff led a 2-hour presentation at the June 2002 TCET Symposium. The Web Library products were demonstrated for the faculty members, and then a lesson on creating multimedia using PowerPoint was taught. Participation by the educators during the presentation provided the TLWL team with feedback about what faculty

members taught, what technology they used, and what topics they wanted online. At the conclusion of the presentation, participants completed a questionnaire targeted at obtaining consumer information. The questionnaire included three questions:

1. How do you use multimedia?
2. How would you use the Web Library?
3. Will you use ADAM? Explain.

The participants submitted the hand-written feedback at the end of the Symposium after they had time to try the TLWL materials.

The feedback from the symposium provided the TLWL team with three pieces of information that resulted in new product development. First, the participants expressed interest in an online tutorial on using PowerPoint to create multimedia presentations. Second, they suggested new topics for ADAM modules. Third, they conveyed their desire to have video products for their students to use in creating presentations. The last request resulted in a new online menu item called Free Media, including a variety of video clips in a PowerPoint-compatible format.

The data from the TCET Symposium provided information from which I could determine a corrupted form of the faculty member's Level of Use (Hall & Hord, 1987) of multimedia materials. The format for questioning and the interviewer were not concerns-based adoption model certified, but they generated similar data about adopter use. Knowledge of how faculty members integrate and use multimedia aided the TLWL team in continuing their development of new tools to accommodate users. This method was useful for gathering information from the product consumers and was adopted by the TLWL team for that purpose.

Feedback From Individuals

As I collected documents from the project for this study; I found many individual written accounts or communiqués. These included emails, hand-written notes, documented phone calls, reports, and letters. For each document, I determined the source and recipient of the feedback, the focus of the communication, the nature of the communication, and the action that resulted. I discuss these documents by categories of feedback source and format.

Communication Between TLWL team members

Email. As the TLWL progressed through five stages of development, the email communication between team members also developed through the stages. Throughout, the focus of communication covered a variety of topics, and only the nature and quantity changed. During Stages 1 and 2, email messages between team members averaged less than one each day. The nature of the communication was either informative or directive. During the second meeting in Stage 3 of the project, team members shared their email addresses with each other. The quantity of email increased, but the nature continued to be predominantly informative or directive. As Stage 3 progressed, more of the email included suggestive feedback and constructive feedback. This progress paralleled the change in team dynamics as team members began working together on the various aspects of the product indicated by protocol outlining product development processes. The change in intra-team collaboration is also evident in remarks recorded in team minutes and in the configuration of the protocol forms developed during this period.

By Stages 4 and 5, the team dynamics were fully developed, with an intricate flow of work process and feedback. Figure 9 illustrates the design team network, and Figure

10 illustrates the production team network. The linking lines in the diagram are broken with the word *Edit* at specific points. These represent internal edits by the team members. The feedback was typically done by email. When the product reached the point of editing, the creating team member sent an email with a link to the prototype product to others on the team. Each team member was assigned a particular editing focus. After testing the product, team members sent the feedback by email to the original team member, who made corrections where necessary. If major alterations were considered necessary, the editing team member sent the feedback to everyone on the team, as well as the team member who originally requested the feedback. This action started a dialog that continued until there was a consensus of the team or the team manager made the decision. As a rule, the email-edit-email cycle lasted no longer than 1 day. When major design issues or technology problems arose, feedback went through several cycles and lasted a week or more.

During the design stages, team members forwarded the completed portion of the product to the next team member, according to the flow chart in Figure 9. If the file was too large to attach in an email, the developing team member uploaded it to the file server, and the receiving team member downloaded it to his or her machine after being sent an email to do so. If the file server was not available, the developer delivered the product to the receiving team member on CD. The last practice disappeared in Stage 5 of the project, and team members transmitted all products electronically.

The production team used the same process described for the design team for edits and feedback (see Figure 10). The production team received the edited product components, listed across the top of Figure 10, from the design team. After the

programmer created the multimedia product from the components, he sent the product online URL to the team through an email. The team members tested the product and sent their edits back to the programmer through email. The programmer sent the edited version of the product to the Web developer, who posted it online. At this point, the Web developer contacted targeted team members through email to test the online modules. All needed edits were reported to the Web developer through an email.

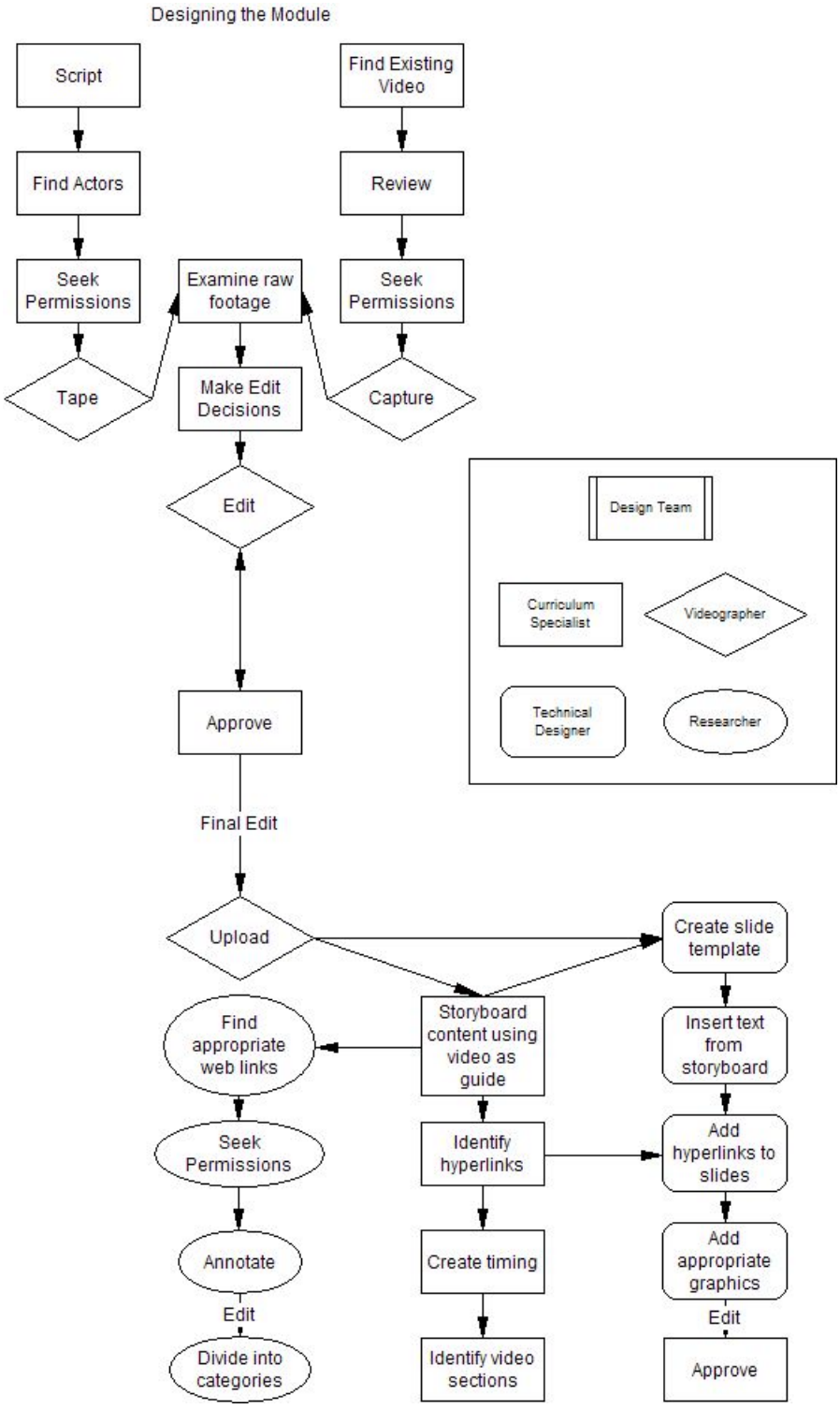

Figure 9. *Workflow diagram for the TLWL design team.*

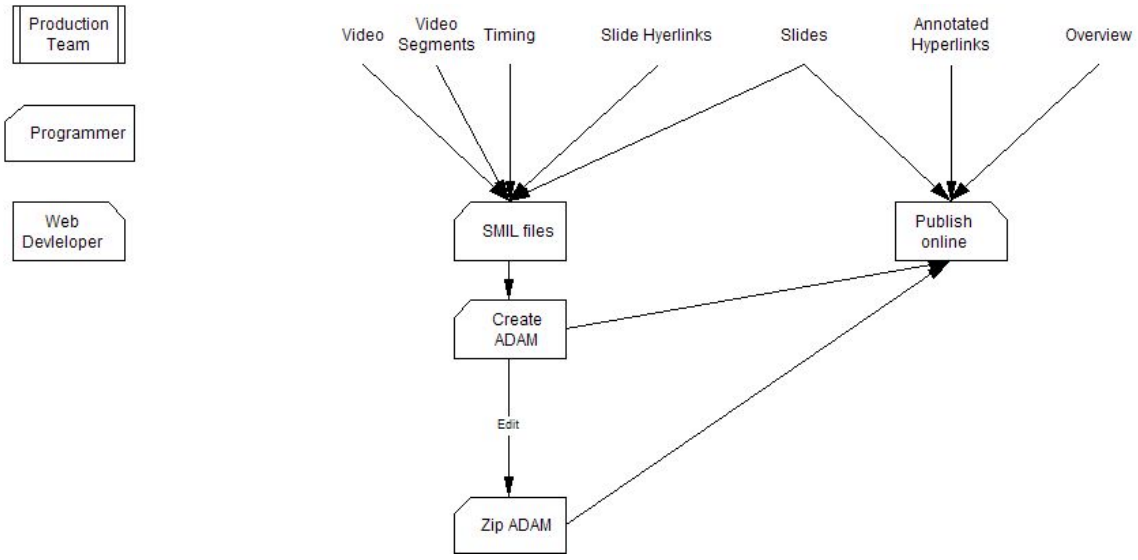

Figure 10. *Workflow diagram for the TLWL production team.*

Reports. Each TLWL team member documented his or her progress and kept track of any product changes made. Once each year, the team member submitted a detailed report to the team manager. Product specifications and upgrades were outlined in the report. Events and details from these reports were compared to significant events identified in Table 5 of this study.

Faculty Advisor Feedback

The TLWL team worked with three faculty members who provided feedback before and during the product development stage. Faculty members had expertise in technology and multimedia. They provided the TLWL team with technical advice as well as the faculty viewpoint as to the product use. Before moving forward on a new product or on a significant product alteration, a TLWL team member would discuss the change with one or more of the faculty advisors. The team member kept written notes from the

meeting and shared them with the entire team during team meetings. Faculty advisors provided input on technology choices and design. The faculty member perspective documented by written notes from the feedback was of foremost consideration by team members during the design and development process. Team meeting minutes documented the impact of faculty advisor feedback.

Individual Tester Feedback

The TLWL team identified individuals outside the team to do tests on the initial or prototype version of the product at the first stages of development. These individuals had enough technical knowledge to run trial tests on the product but were not expert in either technology or product content. The testers were chosen for diversity in computer platforms, operating systems, and internet connectivity. The tester's primary responsibility was to find out if the product functioned properly. He or she tested the product for usability, operability of components such as buttons, functioning of the hyperlinks, and clarity and correctness of instructions. Tester feedback was open-ended. The tester submitted his or her feedback to one of the team members in a handwritten or email communication. Per the tester's feedback, the TLWL team members corrected product errors, deficiencies, inconsistencies, and failures. Team members documented the prototype tester identification, the prototype tester qualifications, and the product test feedback in individual notes.

Consumer Feedback

After the product was launched into the consumer market in its final form, the TLWL team continued to gather feedback. The team manager was responsible for the collection and analysis of this feedback. Venues of documented feedback included

observations of the product in use, interviews with teachers and students using the product, online surveys, and email. Information obtained included how the product was used and how the product was adapted for use. The team manager interpreted the meaning of the feedback and shared the interpretation with the team during the weekly meetings as documented in the minutes. The feedback from these sources furnished the team with ideas for new products and designs based upon consumer use. The development processes of the new ideas were documented in meeting minutes and email correspondence between team members.

Final Comments

Data collected for this study were analyzed using constant comparisons between the documents, as indicated by multiple references during the discussions. The data were coded, and major categories and subcategories emerged. The codes were analyzed by placing the comments and each code into individual columns of a spreadsheet. I then sorted the columns using first one column for primary sorting and then the next column until a pattern appeared. Once a pattern became apparent, I checked it with other data in the study for comparison. These were noted in such comments as "the email communication and minutes showed …" Tables and figures were also derived from these data comparisons.

From the data, six significant groups were identified. These included the TLWL team, the focus group, faculty advisors, prototype testers, beta test groups, and consumers. Analysis of feedback from these groups showed that each group had a different focus of interests and provided different kinds of feedback. The feedback was used by the TLWL at different stages of product development. Three types of product

tests and feedback appeared in this study. The prototype tests occurred early in product development and were focused on the functionality of the product. Beta tests were done on the product to provide feedback for refining the product to enhance its design and thus make it more relevant in the context of the classroom. The consumers provided information to the team on how the product was being use and adapted. From this, the team could redesign or create new products.

The minutes from the weekly TLWL meetings provided chronological events, progress reports, team attitudes, topics of focus, and feedback use. From these documents, I was able to generate critical events charts that eventually led to identifying five stages of progress for the TLWL. Characteristics of each stage pointed me to important factors in the product development and dissemination process, including the role of leadership and the development of team dynamics. A structured feedback network supported the entire process of product development, dissemination, and adoption.

Results from this analysis identified five major factors that are important to the development, dissemination, and adoption of the multimedia products. The first factor was that of leadership. Leadership was important for developing the next factor team dynamics. Leadership and team dynamics worked together to form a strong relationship with a shared vision that worked effectively. The third factor was that of expert advisors. The fourth factor was an established feedback network, and the fifth factor was the consumer. These factors are explained further in chapter 5.

CHAPTER 5

SUMMARY AND THE MODEL

This study was initiated to investigate and identify factors that are important to the development and dissemination of multimedia educational materials and the role that feedback plays in the process. The research involved a case study of the Technology Leadership Institute (TLI) Web Library. I used the grounded theory method to code data collected from the project and maintained the expectation that a generalizable theory would emerge as a result.

The TLI was a Preparing Tomorrow's Teachers to Use Technology grant funded by the federal government in 1999. One component of the TLI project, the Technology Leadership Web Library (TLWL), was the focus of this case study. I assumed the role of full-time team manager at the beginning of the project's 2nd year. Before that, I was involved with the project as a curriculum specialist and then a half-time team manager. The challenge for the TLWL was to create multimedia materials for college faculty to use with preservice teachers. The materials were intended to help faculty and students model and use technology to enhance learning. The TLWL designed the multimedia tools to maximize the flexibility of use and appeal to consumers of all skill levels and teaching/learning styles. These materials were made accessible through the TLWL site.

The TLWL experienced many changes through the 3 years of evolution during which I studied in this research. The team members documented all activities and correspondence. I used a grounded theory open coding procedure to analyze minutes from weekly TLWL meetings; written reports; email, face-to-face as discussions,

observations, and interviews; and questionnaires. I used the variety of feedback sources to support my analysis through triangulation and constant comparisons.

Purpose of This Study

The purpose of this research was to develop a model for the process of development, dissemination, and adoption of an educational multimedia tool. The goal was to create a model that would be different in two major ways from other models. First, it would incorporate all the processes from development through dissemination and adoption into a single model. Other models considered development and adoption separately and at different stages of the project (Ellsworth, 2001). Second, feedback from the user would drive the product development instead of the product driving the user development. Other models (Hall & Hord, 1987) discussed the right uses and wrong uses of the product. The product I studied was designed for flexibility so that just getting the product used in any way the consumer felt comfortable was the focus. The feedback was designed to diagnose need for change in the product itself as opposed to the need for change in the consumer's use of the product.

I found that five major factors contributed to the multimedia development, dissemination, and adoption of the TLWL product. These factors were leadership, team dynamics, expert advisors, feedback networks, and consumers. I discuss each of these factors in Research Question 1. The importance of feedback in the process is discussed in Research Question 2. The results of this study led to a new model called the PROMOTE model. The model is explained in this chapter and compared to existing models.

The Five Major Factors

As discussed previously, five major factors emerged from this study that need to be considered for the development, dissemination, and adoption of educational multimedia materials for faculty. They are leadership, team dynamics, expert advisors, feedback, and the consumer. According to my research, these factors need to be taken into account at the beginning of the project, and the proper people and protocols need to be put into place if the project is to be efficient and effective in the development, dissemination, and adoption of its products.

The team manager needs to understand the change process and the targeted user groups. The team manager must be able to communicate his or her vision to the team and thus create a shared vision. The team manager must be able to provide the appropriate kinds of feedback and understand individual team member needs. The team manager must develop effective protocols for the various processes or workflow and communication and be able to interpret and analyze feedback for the team.

Strong team dynamics means a loyal, unified group with a shared purpose. Team members must be able to communicate well with one other and constantly support each other's efforts. Team members must pull together during change and embrace the positive results of change. A dynamic team means that the team members have diverse skills and complementary talents.

Expert advisors provide content knowledge and technology expertise. They work with the team during all stages of product development and provide a final user perspective for the design and development team. Their feedback is candid and is provided on a one-to-one basis or in a group situation.

Systematic feedback is needed to enhance the entire process of product development and dissemination. Feedback loops should control feedback source-recipient flow and clarify information flow. The feedback network should be built at the beginning of the project, and every person participating in any aspect of the project should be made aware of it.

The consumers are also referred to as the end users but should be considered before product development. User characteristics should be calculated, along with product design. Understanding the consumer preferences also facilitates dissemination by knowing the best channels for reaching the user.

Research Question 1

What major factors need to be considered in the development, dissemination, and adoption of multimedia materials for teacher education faculty?

As a result of this study, I determined that there are five major factors that must be considered in the development, dissemination, and adoption of educational multimedia materials. These factors are leadership, team dynamics, expert advisors, feedback, and the consumer.

The Leadership Factor

Leadership defined Stages 1, 2, and 3 of the TLWL project. No leadership was exhibited during Stage 1. There was no single source of directives and no follow-up on assigned tasks. During the first 6 months of the Web Library, there was a continuing effort at the meetings to define the project. Without a leader, no single vision for the project existed, and goals continued to change. There were no regular team meetings, and team members expressed confusion about what they were supposed to be doing for the

project. The documented meetings occurred between inconsistent two-person combinations that made decisions that were not communicated back to the rest of the team with any regularity. As a result, the data show that few of the decisions were executed. The TLWL staff focused most of their efforts during this time on locating resources. Lack of leadership appeared to be detrimental to project progress.

A half-time team manager was assigned to lead the team at the beginning of Stage 2. Weekly meetings were scheduled, and attendance was mandatory. The weekly meetings were led by the team manager, and meeting agendas were established. Product production increased, and work protocols were established. The leadership was sporadic however, because the team manager was often absent while attending to other duties. During the periods in which the team manager was gone, meetings ceased to occur. Email correspondence indicated unhappiness with the development process during this time. Leadership was weak but evident.

Strong leadership was the signature for Stage 3. At the beginning of this stage, the team manager position became full time. The team manager focused on developing two major components of the project, team dynamics and product attributes. The team manager began to develop a team concept with a shared vision. Protocols were developed to define the team dynamics. A new product and a new Web site were developed.

The team manager used strategies for change in considering user characteristics and product attributes. The team manager gathered information on user characteristics and preferences from faculty and students and shared this information with team members. The topic of dissemination was introduced and discussed at the team meetings.

Leadership continued to be strong during Stages 4 and 5. The style of leadership changed from mostly directive to informative and suggestive. Team members in the weekly meetings echoed the leader's vision. The team leader became the conduit for most of the outer-circle feedback, interpreted feedback evaluation results, and shared the information with the team. The leader's emphasis on user characteristics and product attributes and the developer's application of these ideas improved the quality of the product, according to evaluator feedback through the focus group. Users began to respond by increased use of the product and the development of collaborative groups who desired to be part of the project through product development and product use. As collaborative groups became part of the development process, the team manager developed new protocols establishing workflow and feedback loops. Leadership of the TLWL supported the team through the changes and the project continued to move forward. Even during long periods of team manager absence, the team continued to meet weekly, to keep minutes, and to develop new product.

Team Dynamics Factor

According to the data, when individuals worked on the products in isolation they were not as successful as when the entire team shared in working on a product. During the first 6 months, the period labeled Stage 1 of the project, individuals worked on the product with no interaction between workers. Each person worked alone on a product module. The job descriptions changed frequently, and workers were not sure what was expected of them. There were no team dynamics because no unified team was established. Feedback from managers was directive, and feedback loops were not instituted.

In Stage 2, the team manager began to put together the remnants of a team. The most substantial indication of team dynamics was the scheduling of weekly mandatory meetings where team members had an opportunity to obtain feedback about the project and share ideas with one another. Project development protocols were discussed during the meetings. The communications were mostly informative and directive, with team members continuing to work alone on the different aspects of the project. The weakness of the team cohesiveness was exposed when the team dissolved during the team manager's absence.

The development of team dynamics characterized Stage 3. The team manager began that period of the project by hiring team members rather than individuals to do a job. Meetings were focused on building team dynamics by developing a shared vision, team dependent relationships, protocols for workflow and feedback, and the growth of team loyalty. A new multimedia product was embraced during Stage 3, and the team began focusing upon working together to improve the quality of the product. Team members shared suggestive feedback during team meetings and relied on one another to provide constructive feedback for edits.

The topic of team development continued through Stages 4 and 5 as the team began working with collaborating groups and developing new products. Email communications indicated that the team members learned to work efficiently together as response time for suggestions and edits quickened and product development time decreased. As the team improved, so did the multimedia product.

Expert Advisors Factor

Faculty advisors and the focus group acted as the primary expert advisors for the TLWL. These people were present throughout the project and helped maintain quality control. They provided help with technology, advice on pedagogy, content knowledge, and faculty users' perspectives on using the multimedia products in teaching. The focus group provided periodic feedback, and there was almost no interaction between that group and the TLWL team. The team manager received focus group feedback, interpreted it, and discussed it with the team members. The faculty advisors were available to the team members as needed. The team manager met with them at times to discuss new products and new directions for content, design, and technology. The individual team members called upon the faculty for guidance to help with technical issues that surfaced occasionally. The quality of the product depended on having access to these experts.

The Feedback Factor

At the beginning of the TLWL project, no feedback structure was in place. Confusion resulted from team member's lack of knowledge about where directive feedback initiated and to whom project reporting should be directed. The uncertainty created frustration and product production suffered.

Feedback protocols were developed beginning in Stage 2 of the project, and they continued to be adjusted and refined through Stage 5. Feedback was initially aimed at the development and production teams to enhance the flow work. Team members knew from whom they received materials, who and when to call for reviewers to edit product, and to whom they passed their work. The workflow process increased production efficiency and provided a mechanism that could be tracked for progress reports. It also provided a

diagnostic tool to determine where work bogged down and where more staff or equipment was needed.

The team manager tightened the feedback network and provided more direction at the beginning of the project's Stage 4. Collaborative partners became part of the communication system and added complexity to the structure. The team manager closed some communication paths and acted as a funnel for all feedback from collaborative partners, beta test groups, and consumers. Team members received the groups' feedback from the team manager. As a result, the team development and production process were not affected by the addition of collaborative partners, and evaluative feedback from test groups and consumers was clarified.

Evidence of the need for a well-defined feedback network came from incidents at the initial stages of collaboration. Partner members worked directly with team members, who experienced some confusion about who was directing product development and production. Some misunderstandings occurred and were resolved by leaders of the TLWL team and the collaborating team. Once the feedback network was established and enforced, team leaders communicated with each other and then each leader communicated with his or her team members. The process was smooth, and as new partners were added, the network was explained, and the partnership developed seamlessly.

The Consumer Factor

Educational faculty members were the targeted users of the multimedia product developed by the TLWL project. Concentration on this group did not come into focus until Stage 3 of the project. After the product began to reflect user characteristics and to

meet user needs, consumers began to take notice and try it. Beta test groups that were analogous to the user groups provided feedback about the relative advantage of the product (Rogers, 1995), issues of relevancy, user friendliness, and user control.

Understanding who the consumer is, what the consumer is willing to use, and how the consumer will use it constitute an important first step to product development. The TLWL team did not begin with that focus, but after turning in that direction experienced positive changes in user adoption and increased success in product dissemination. The team members brainstormed ideas for avenues of dissemination; then, using what had been discovered about user characteristics, they focused on the most effective dissemination options for the target audience.

As the TLWL team developed and disseminated multimedia products, they discovered that the process did not end with consumer adoption. Feedback from the consumer group was used to generate new products based on the use and adaptations developed around the products. As users modified their applications of the products, project developers created and adapted multimedia tools to enhance the new applications, and thus a complete cycle of development, dissemination, and adoption was created. This cycle began with the end user and moved forward to product development as a second step.

Research Question 2

How can feedback be used to guide the process from research and development through dissemination and adoption?

A well-developed feedback network was an essential element of the TLWL project. As the project grew and more people became involved, stricter protocols kept the

product development and production process running smoothly. Feedback was tightly monitored between communicating parties to keep confusion to a minimum. Team members could communicate freely among themselves, the advisors, and the prototype testers, but other communication links were discouraged. The team manager provided a conduit for feedback between team members and other groups.

Team Feedback

The type and format of team feedback evolved throughout the project. Weekly meetings provided team members with an opportunity to share suggestions, report progress, and express constructive opinions. During these meetings, the team manager provided team members with directives, information, and suggestions. Email communication increased in importance over the course of the project. Email became the customary form of in-process communication for product development. Team members solicited comments, suggestions, and edits from each other.

Tester Feedback

Prototype testers. After design and development, the first version, or prototype, was produced. Testers checked the product for functionality or usability. The prototype testers were purposely chosen because they were not experts in technology or content knowledge. The TLWL team did not want to slow production because of individual preferences or suggestions concerning product change. The experts and the team had already made technology and content decisions at this point.

Feedback from the prototype testers usually consisted of hand-written notes or email. The content included whether the buttons did what was required, the links functioned, and the software actually performed properly on the computer. Prototype

testers tried the software on various machines, with different Web browsers and screen resolutions, and for both dialup and network connections. Feedback was open-ended without an itemized form to complete. In many instances other team members prototype-tested the product for the developing team member. Before going to the next step of production, a person outside the team always made a test.

Prototype testers and team members worked directly with one another. When the product reached the stage of testing, the team member responsible passed it on to the tester. The tester then provided the feedback to the team member without going through the team manager. Every feedback comment from the tester was taken into consideration, and all corrections were made before moving the product to the next level of development.

Beta Testers. Beta testing was done in groups. After prototype testing of the product showed that it was considered to be functioning properly, beta test groups received the product for trial. These groups had the same characteristics as the users and were higher education faculty, teachers, or students. The beta test groups were comprised of people who agreed to beta test the product and understood what that meant.

The team manager collected and analyzed the feedback from beta test groups. Questionnaires and surveys, along with group discussions, were the formats of data collection. Beta testers used the product or experimented with it in a controlled environment and then provided feedback. The beta testers considered the multimedia products in the context of the teaching and learning environment. Questions included the perceived relative advantage (Rogers, 1995) of the product, the relevancy of the technology design and content materials, user friendliness, and preferred user controls.

The focus of the beta evaluation was to gather feedback based on group consensus. The team typically ignored feedback that reflected individual preferences. From the results of the feedback, the product was adjusted and refined to fit the consumers' user styles.

Consumer Feedback

The team manager collected feedback from the consumer by email, surveys, interviews, and observations. The content of the most beneficial feedback provided information about the Levels of Use (Hall & Hord, 1987) of the product by the consumer. It should be noted that the team manager was not certified in the concerns-based adoption model and thus the LoU feedback was a compromised version of the authentic CBAM tool. By understanding how the product was being used, the team manager and team members could best fit the multimedia tool to meet the user's need. When the consumer adapted the product to integrate into teaching and learning, feedback generated new ideas for TLWL products.

Flexibility of product design was a major goal for product development; thus, how each user personalized the product gave insight into design issues. As the cycle of product development continued, the user became the first step in the cycle leading to the design of a prototype, beta testing, and back to the user.

The Role of Feedback

Through every step of the process from the initial idea, design, development, production of a prototype, and beta testing to dissemination and consumer adoption, systematic and controlled feedback was shown to be a crucial element. Understanding the type of feedback needed at each stage of the process and directing the feedback from

source to recipient appears, according to the data, to produce an effective and efficient process for product development and dissemination. Including feedback from the end user completed the feedback cycle and encouraged the continuing development of new product designed for the consumer.

The PROMOTE Model

From the analysis of the data and the answers to the two research questions posed in this study, a model for multimedia materials development, dissemination, and adoption emerged. I call it the PROMOTE model, which is an acronym for Process Revolving around Ongoing Management of Team and Evaluative feedback. The model encompasses the five major factors that I found from the first research question and illustrates the feedback loops researched in Research Question 2. The model is illustrated in Figure 11.

The center of the model is a circle that represents all aspects of the innovation development and production. Inside the circle is a triangle that represents the processes of analysis, development, and research. The project begins with a needs assessment that is developed as a result of research and analysis of the users and the environment. Continuously during the product development, the product refinement, and the product production, research and analysis occur. These processes are symbolized by the triangle at the center of the diagram. Around the outside of the triangle, but still inside the circle, are the persons required for the development of the product. These people include the leader, team members, and expert advisors. Inside the circle, the team generates ideas, designs product, develops materials, and produces the multimedia products. Feedback and workflow protocols are well established inside the circle. Quality control is

monitored. The leadership keeps the circle intact, and the team dynamics keep the process moving. The content experts maintain product content quality.

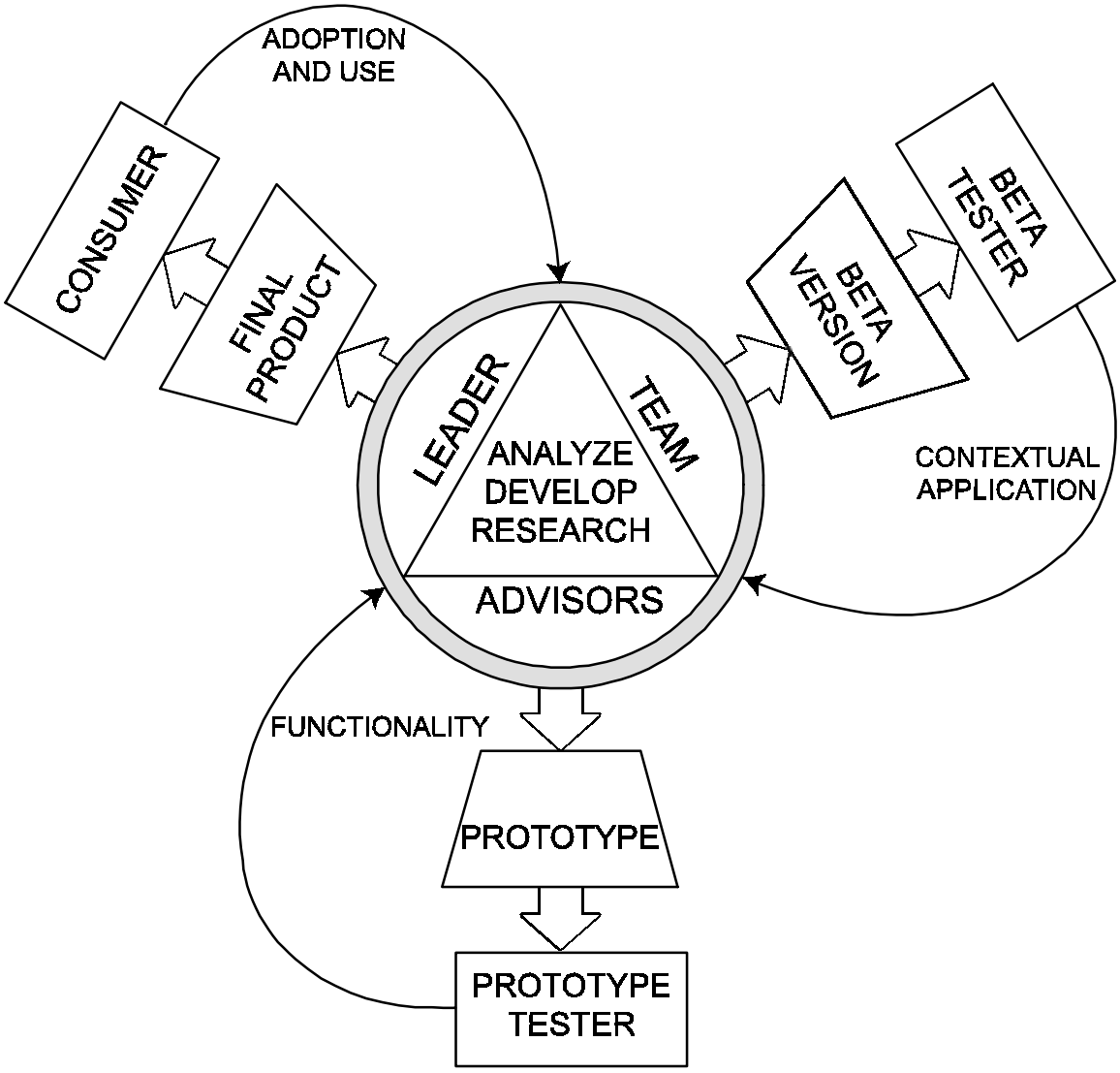

Figure 11. *The PROMOTE model.*

Extending from the bottom point on the circle is a block arrow representing the product flow. The product prototype is passed along to a prototype tester, who checks it for functionality. The line arrow represents the feedback from the tester to the team. The team uses the feedback to correct problems with the prototype. Following the dotted line

from the feedback arrow through the circle leads to a block arrow representing the beta version of the product. The beta tester group experiments with the product and generates feedback that reflects the product's use in the context of teaching and learning. Feedback includes issues of content and technology relevancy in the classroom, user control needs, and user-friendly issues. The contextual application feedback leads back to the circle, where minor adjustments are made to the product to bring it in line with user wants. Following the dotted line through the circle leads to the final product. Here the product is distributed to the consumer, who decides whether to use it. Feedback to the team circle is focused on how the product is being used or why it is not used and how the product is being integrated and adapted. In addition, user management issues are important to the team. This adoption and use feedback is similar to the CBAM (Hall & Hord, 1987) Levels of Use. The feedback from the consumer leads back to the team circle and is used to generate a new product, which starts the process over again.

This model is unique for two reasons. First, as a development and dissemination model it is iterative and symmetric. Starting anywhere on the model, product development, dissemination, and adoption can be completed, and the cycle is continuous. Other RDD models fail to join the components from development to adoption into a single cycle. The reason could be that other models approach the development and dissemination process as a linear process with a beginning and an end. Each aspect of the process is viewed individually. This could be the result of empirical data generated at the end of the dissemination process and thus developing an incomplete picture, compared to the broad approach taken in this study.

Second, as an innovation adoptions model, the PROMOTE model contains a feedback loop from the consumer back to the development group. Other models provide feedback for the purpose of training users to handle properly the innovation, not for changing the innovation to meet the user's desires. This feedback does not typically go to the development group. I believe that most of the time the feedback from these models reaches a dead end and there is no action taken. Although the model is built around the intent that the feedback will be used to build a prescription for change, I think that most of the time interest in the innovation dies as new products become available. I do not believe that the feedback reaches the original design team because the team either dissolves after creating the product or moves on to developing a new product. The PROMOTE model provides a continuous flow of new products designed to meet the users' developing skills and knowledge, as well as the new emerging technologies based on feedback at every stage of development.

The PROMOTE model presents a new way of considering the diffusion of an innovation. Instead of focusing on the process of analysis, development, diffusion, and evaluation as the model, the PROMOTE model focuses on the process involved with teamwork and feedback. Unlike the RDD and systems theory models that usually begin with a needs assessment, the PROMOTE model begins with the establishment of a structured system fueled by leadership and kept in motion by a feedback network.

The PROMOTE model feedback network includes feedback from well-defined sources providing selective information. Feedback is gathered from prototype testers, beta group testers, and consumers. Feedback from the consumers provides constructive information for new product development. A form of the CBAM Levels of Use is used to

gather consumer information. The LoU feedback is used to guide product development rather than to guide user behavior. According to Shirley Hord (personal communication, September, 2002), this is a somewhat unorthodox but acceptable use of the instrument. She also included that she believed the PROMOTE model feedback network was "right on target."

Outcome of the Study and Its Relation to Theory and Literature

From the results of this study, I was able to create a model that explained the relationships between the major factors involved in multimedia product development and the significance of feedback in the entire process. My intent was that the new theory that evolved through this research would be more than a culmination of existing theories. The data collection and analysis were unusually comprehensive for a diffusion research project. The open coding process allowed me to work from an entirely new perspective and use the data linkages to make sense of what was happening.

The diffusion and systems theory models included in this research were reflective of most instructional development models. The processes described by these models include some variation of a universal five-step model: research and analysis, development, dissemination, adoption, and evaluation. The model developed in this study focused on establishing a system that included leadership management, a production team, expert advisors, testers and users, and a well-defined feedback network. The model processes outlined in the literature were integral parts of the system's internal processes in this study, but they were not part of the system's overall structure.

The evaluation component of this study contrasted with the typical evaluation focus of the models discussed in the literature. Customarily, product is generated for a specific use. Evaluation feedback is used to diagnose problems concerning how the product responds to the user or how the user responds to the product. The product in this study was developed to provide the user with the maximum flexibility. The focus during production was to get the product in the hands of the consumers and to get it used any way possible. Feedback provided the team with information that allowed for product modification and creation to further its use at a continuing higher level. The model resulting from this study reflected the process of feedback and evaluation required to accomplish this form of evaluation.

Recommendations for Further Study

The following are five recommendations for further study of this model:

1. This model needs to be applied to a curriculum development project and the results studied.
2. A study of feedback loops from final users needs to be done to determine where the information goes and what actions are taken as a result.
3. A developing project using this model needs to be monitored and analyzed to determine the effectiveness of the model.
4. Feedback and evaluation tools need to be developed that can be applied to the various feedback loops in the model.
5. Consumer feedback needs to be monitored over a longer period of time to determine the significance of the model on adopters.

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